NPL-U29-2-9-R8

HRS DOCUMENTATION RECORD--REVIEW COVER SHEET

Name of Site: Basin Mining Area

Contact Persons

Site Investigation: David Williams, EPA Region VIII NPL Coordinator, (303) 312-6757

Documentation Record: David Williams, EPA Region VIII NPL Coordinator, (303) 312-6757

Pathways, Components, or Threats Not Scored

Ground Water Migration Pathway

The ground water pathway was not scored because of the lack of a documented observed release to ground water.

Surface Water Migration Pathway

The ground water to surface water migration component was not scored because the surface water pathway score was maximized by the overland flow/flood migration component.

Air Migration Pathway

There are insufficient data to satisfy HRS requirements for establishing an observed release of arsenic to the air. Without an observed release, only potential to release may be evaluated for this pathway, and this minimally impacts the overall site score.

BASIN MINING AREA
Basin, Montana

The Basin Mining Area site is located within the Boulder River watershed, and consists of characterized, uncontained mine tailings piles and areas of soil contamination resulting from precious metal mining activities. Mining activities included hard rock mines where veins of quartz, tourmaline, pyrite, galena, tetrahedrite, sphalerite, arsenopyrite, chalcopyrite, and siderite within the Cretaceous Boulder Batholith were explored. Tailings piles are located along Basin and Cataract Creeks and within and adjacent to the Basin town limits. The Town of Basin is situated near the confluence of the Boulder River and Basin Creek. Mining activities in the Basin Mining Area commenced in the late 1800s and continued intermittently into the 1960s. Metals extraction included milling and smelting of ore within the Town of Basin.

Although there are several mines and mills located in the Basin Mining Area comprised of the Basin Creek and the Cataract Creek drainages, and the Town of Basin, not all have been scored using the Hazard Ranking System (HRS) because of the lack of sufficient source or attribution information, lack of evidence supporting an observed release to the surface water or soil exposure pathways, or the available information and analytical data suggests that identified targets are minimally impacted. Therefore, the following sources have been evaluated for the Basin Mining Area: Bullion Mine, Buckeye-Enterprise Mine-Mill, Crystal Mine, Boulder Chief Mine, Eva May Mine, Basin Tailings, Jib Tailings, and contaminated soil.

A Montana Bureau of Mines and Geology, Abandoned-Inactive Mines (MBMG AIM) report indicated that the Bullion mine and Buckeye-Enterprise mine in the Basin Creek drainage, and the Crystal mine in the Cataract Creek drainage appear to be major contributors to the dissolved-metals loading in the creeks. The group of mines in the Jack Creek drainage were noted as having the greatest individual and collective impact of any other in the Basin Mining Area. The samples collected from Basin Creek below all of the sampled mines had elevated arsenic concentrations; the MBMG AIM program report indicated possible entrance of ground water and sediments via the Basin Belle or Daily West mines.

The EPA Field Investigation Team (FIT) contractor conducted a Screening Site Inspection (SSI) in 1989 at which time the site was known as the Basin Mining Site. In 1991, the FIT conducted an Expanded Site Inspection at which time the site became known as the Basin School Yard Site. The EPA Technical Assistance Team conducted a sampling event in the environs of the Basin School in January of 1990, and the Montana Department of Health and Environmental Sciences sampled the Basin School Yard soils in April and June of 1990. Samples collected during the 1989 SSI from tailings piles located in and around Basin revealed elevated levels of arsenic, cadmium, copper, lead, manganese, mercury, silver and zinc in the uncontained sources. Surface soil contamination was documented from the three sampling events to exist on residential properties within the Town of Basin. Arsenic was detected in surface soil samples collected from the Basin School playground area at concentrations exceeding the cancer risk benchmark. Basin School officials were advised by the Montana Health Department to restrict student access to documented and suspected areas of contamination on the school's property.

Surface water and sediment samples collected during the 1989 SSI indicated that hazardous substances attributable to the site, specifically arsenic, copper, lead, silver and zinc, were being released from site sources to the Boulder River. Surface water and sediment samples collected during the 1993-1994 Montana Department of State Lands, Abandoned Mine Reclamation Bureau indicated that hazardous substances attributable to the mines, specifically arsenic, cadmium, copper, iron, lead, manganese, mercury, silver, antimony, and zinc in uncontained sources within the Basin Mining Area were being released to surface water. The MBMG AIM samples identified elevated levels of arsenic, cadmium, copper, lead, and zinc in samples collected during their study.

The Boulder River, Basin Creek, and Cataract Creek transect the Basin Mining Area site and are documented recreational fisheries. The State of Montana has classified the Boulder River and Cataract Creek as level B-1 surface water bodies for drinking, culinary, and food processing purposes after conventional treatment. The Basin Creek drainage has been classified by the State of Montana as an A-1 surface water body. This classification designates the section of Basin Creek included in the target distance limit for use as drinking, culinary and food processing purposes after conventional treatment

[The description of the site (release) is based on information available at the time the site was scored. The description may change as additional information is gathered on the sources and extent of contamination. See 56 FR 5600, February 11, 1991, or subsequent FR notices.]

HRS DOCUMENTATION RECORD

Name of Site: Basin Mining Area

CERCLIS ID: MTD982572562

EPA Region: VIII

Date Prepared: July 21, 1999

Street Address of Site: near Basin, Montana - Sections 17 & 18, Range 5 West, Township 6 North

County and State: Jefferson County, Montana

General Location in the State: The Town of Basin, Montana is 35 miles north of Butte, Montana in the southwest quarter of the state.

Topographic Map: The location of the site is shown on the following USGS 7.5' Topographic Maps: Basin, MT, Mount Thompson, MT, Three Brothers, MT, and Chessman Reservoir, MT (Ref. 6).

Latitude: 46° 16' 22" North

Longitude: 112° 15' 48" West

<u>Scores</u>

Air Pathway	0.00
Ground Water Pathway	0.00
Soil Exposure Pathway	70.40
Surface Water Pathway	100.00
HRS SITE SCORE	**61.15**

WORKSHEET FOR COMPUTING HRS SITE SCORE

		S	S^2
1.	Ground Water Migration Pathway Score (S_{gw}) (from Table 3-1, line 13)	_NS_	_NS_
2a.	Surface Water Overland/Flood Migration Component (from Table 4-1, line 30)	100	
2b.	Ground Water to Surface Water Migration Component (from Table 4-25, line 28)	NS	
2c.	Surface Water Migration Pathway Score (S_{sw}) Enter the larger of lines 2a and 2b as the pathway score.	_100_	10,000
3.	Soil Exposure Pathway Score (S_s) (from Table 5-1, line 22)	_70.40_	4,956.16
4.	Air Migration Pathway Score (S_a) (from Table 6-1, line 12)	_NS_	_NS_
5.	Total of $S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		14,956.16
6.	**HRS Site Score** Divide the value on line 5 by 4 and take the square root	61.15	

NS = Pathway not scored

TABLE 4-1
SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

Factor Categories and Factors	Maximum Value	Value Assigned
Drinking Water Threat		
Likelihood of Release:		
1. Observed Release	550	550
2. Potential to Release by Overland Flow:		
2a. Containment	10	
2b. Runoff	25	
2c. Distance to Surface Water	25	
2d. Potential to Release by Overland Flow (lines 2a[2b+2c])	500	
3. Potential to Release by Flood:		
3a. Containment (Flood)	10	
3b. Flood Frequency	50	
3c. Potential to Release by Flood (lines3a×3b))	500	
4. Potential to Release (lines 2d+3c, subject to a maximum of 500)		
5. Likelihood of Release (higher of lines 1 and 4)	500	
	550	550
Waste Characteristics:		
6. Toxicity/Persistence	(a)	0
7. Hazardous Waste Quantity	(a)	0
8. Waste Characteristics	100	0
Targets:		
9. Nearest Intake	50	0
10. Population		
10a. Level I Concentrations	(b)	0
10b. Level II Concentrations	(b)	0
10c. Potential Contamination	(b)	0
10d. Population (lines 10a+10b+10c)	(b)	0
11. Resources	5	0
12. Targets (lines 9+10d+11)	(b)	0
Drinking Water Threat Score:		
13. Drinking Water Threat Score ([lines 5×8×12]/82,500, subject to a maximum of 100)	100	0
Human Food Chain Threat		
Likelihood of Release:		
14. Likelihood of Release (same value as line 5)	550	550

Waste Characteristics:		
15. Toxicity/Persistence/Bioaccumulation	(a)	2×10^8
16. Hazardous Waste Quantity	(a)	10,000
17. Waste Characteristics	1,000	1,000
Targets:		
18. Food Chain Individual	50	45
19. Population		
19a. Level I Concentrations	(b)	0
19b. Level II Concentrations	(b)	0.06
19c. Potential Human Food Chain Contamination	(b)	0.00003
19d. Population (lines 19a+19b+19c)	(b)	0.06003
20. Targets (lines 18+19d)	(b)	45.06003
Human Food Chain Threat Score:		
21. Human Food Chain Threat Score ([lines 14×17×20]/82,500, subject to a maximum of 100)	100	100
Environmental Threat		
Likelihood of Release:		
22. Likelihood of Release (same value as line 5)	550	550
Waste Characteristics:		
23. Ecosystem Toxicity/Persistence/Bioaccumulation	(a)	2×10^8
24. Hazardous Waste Quantity	(a)	10,000
25. Waste Characteristics	1,000	1,000
Targets:		
26. Sensitive Environments		
26a. Level I Concentrations	(b)	0
26b. Level II Concentrations	(b)	10
26c. Potential Contamination	(b)	0
26d. Sensitive Environments (lines 26a+26b+26c)	(b)	10
27. Targets (value from line 26d)	(b)	10
Environmental Threat Score:		
28. Environmental Threat Score ([lines 22×25×27]/82,500, subject to a maximum of 60)	60	60
Surface Water Overland/Flood Migration Component Score for a Watershed		
29. Watershed Score[c] (lines 13+21+28, subject to a maximum of 100)	100	100
Surface Water Overland/Flood Migration Component Score		
30. Component Score (S_{of}) [c] (highest score from line 29 for all watersheds evaluated, subject to a maximum of 100)	100	100

TABLE 5-1
SOIL EXPOSURE PATHWAY SCORESHEET

	Factor Categories and Factors	Maximum Value	Value Assigned	
	RESIDENT POPULATION THREAT			
	Likelihood of Exposure			
1.	Likelihood of Exposure	550		550
	Waste Characteristics			
2.	Toxicity	a	10,000	
3.	Hazardous Waste Quantity	a	100	
4.	Waste Characteristics	100		32
	Targets			
5.	Resident Individual	50	50	
6.	Resident Population			
	6a.Level I Concentrations	b	270	
	6b.Level II Concentrations	b	10	
	6c.Resident Population (lines 6a + 6b)	b	280	
7.	Workers	15	0	
8.	Resources	5	0	
9.	Terrestrial Sensitive Environments	c	0	
10.	Targets (lines 5 + 6c + 7 + 8 + 9)	b		330
	Resident Population Threat Score			
11.	Resident Population Threat (lines 1 x 4 x 10)	b		5,808,000
	NEARBY POPULATION THREAT			
	Likelihood of Exposure			
12.	Attractiveness/Accessibility	100	0	
13.	Area of Contamination	100	0	
14.	Likelihood of Exposure	500		0

TABLE 5-1
SOIL EXPOSURE PATHWAY SCORESHEET
(continued)

Factor Categories and Factors		Maximum Value	Value Assigned	
NEARBY POPULATION THREAT (Concluded)				
	<u>Waste Characteristics</u>			
15.	Toxicity	a	0	
16.	Hazardous Waste Quantity	a	0	
17.	Waste Characteristics	100		0
	<u>Targets</u>			
18.	Nearby Individual	1	0	
19.	Population Within 1 Mile	b	0	
20.	Targets (lines 18 + 19)	b		0
	<u>Nearby Population Threat Score</u>			
21.	Nearby Population Threat (lines 14 x 17 x 20)	b		0
SOIL EXPOSURE PATHWAY SCORE				
22.	<u>Soil Exposure Pathway Score</u>[d] (S_s), (lines [11 + 21] ÷ 82,500 subject to a maximum of 100)	100		70.40

[a] Maximum value applies to waste characteristics category.
[b] Maximum value not applicable.
[c] No specific maximum value applies to factor. However, pathway score based solely on terrestrial sensitive environments is limited to maximum of 60.
[d] Do not round to nearest integer.

REFERENCES

Reference
Number   Description of the Reference

1. US Environmental Protection Agency (EPA) Hazard Ranking System. 55 FR 51532-51667. December 14, 1990. Included by Reference. Total pages: 1.

2. Superfund Chemical Data Matrix. June 1996. Included by Reference. Total pages: 1.

3. Analytical Results Report, Basin School Yard Site, Basin, Montana. EPA ID MTD982572562, prepared by Morrison Knudsen Corporation, April 28, 1992. Total pages: 99.

4. Field Activities Report, Expanded Site Inspection, Basin Schoolyard, Basin Montana, Prepared by Ecology and Environment, Inc., October 4, 1991. Total pages: 43.

5. Analytical Results Report, Basin Mining Site, Basin, Montana, Prepared by Ecology and Environment, November 10, 1989. Total pages: 101.

6. US Geological Survey (USGS). 1985. Topographic, 7.5 minute quadrangles maps of the Basin, Mount Thompson, , Chessman Reservoir, and Three Brothers, Montana. Two maps.

7. Aerial photograph of Basin, Montana, Montana Highway Department, June 11, 1979, scale: 1 inch to 500 feet. Total pages: 2.

8. Report of Sampling Activities, Basin Mining Site, Basin, Montana. Prepared by Ecology and Environment, August 8, 1989. Total pages: 36.

9. Knudson, Ken; "A Review of Impacts to the Trout Fishery and Interim Reclamation Recommendations," Boulder River, Jefferson County, Montana, August, 1984. Total pages: 23.

10. Record of Communication of Kirk Eakin, URS Greiner Woodward Clyde (URSGWC), searching the National Wetlands Inventory website, http://www.nwi.fws.gov/, regarding the availability of National Wetland Inventory maps for the site area, on May 18, 1999. Total pages: 1.

11. US West, Telephone Directory for the Boulder-Basin, Montana area, 1994. Total pages: 6.

12. US Geological Survey (USGS). 1963. Geology of the Basin Quadrangle, Jefferson, Lewis and Clark, and Powell Counties, Montana. Geological Survey Bulletin 1151. Total pages: 6

13. Memorandum to File from Sabrina Forrest, Tetra Tech EM, Inc. (TtEMI), regarding legal addresses for Town of Basin residences sampled during EPA investigations. June 23, 1999. Total pages: 2.

14. Logbook of FIT sampling activities for the Basin Mining Site Expanded Site Inspection, Ecology and Environment, Inc., July 31-August 2, 1991. Total pages: 43.

15. Memorandum of Phone Call between Kirk Eakin, URSGWC, and Patricia Roberts, Montana Department of Commerce, regarding the state census data for Jefferson County, Montana and the Town of Basin on May 17, 1999. Total pages: 2.

16. Letter from Duane Robertson, Bureau Chief of the Montana State Department of Health and Environmental Sciences to Micki Graham, Basin School Board member, regarding arsenic contamination in Basin School Yard soils, dated April 12, 1990. Total pages: 2.

17. Laboratory Response to Results of Contract Compliance Screening for Case No. 12329, Sample Delivery Groups MHL924 and MHL934, Data Chem, Inc., September 5, 1989. Includes legible copies of Form 1s from 1989 FIT sample analyses. Total pages: 116.

18. US Geological Survey (USGS). 1963. Bulletin 1151, "Geology of the Basin Quadrangle Jefferson, Lewis and Clark, and Powell Counties, Montana". Total pages: 12.

19. Surface Water Quality Standards and procedures for the State of Montana, Administrative Rules of Montana, Section 17.30.602. Total pages: 11.

20. US Geological Survey (USGS) Water-Data Report MT-93-1, Water Year 1993. Total pages: 3.

21. Letter from Carol Fox, CERCLA Program Manager for the Montana State Department of Health and Environmental Sciences to Micki Graham, Basin School Board member, regarding April 1990 sampling of Basin Schoolyard, dated May 17, 1990. Total pages: 10.

22. Jefferson County, Montana, Tax Assessors Office. 1999. Legal descriptions for residences sampled during US Environmental Protection Agency (EPA) 1991 investigation and EPA 1989 investigation of the Basin School. Total pages: 14.

23. Record of Communication between Kristin Cottle, URSGWC, and Kirby Gray, SVL Analytical, regarding solid matrix Contract Required Detection Limits for the US EPA Contract Laboratory Program, Statement of Work, ILM02, on June 17, 1999. Total pages: 1

24. Sample Quantitation Limit calculations. 1999. Compiled by URSGWC. Total pages: 8.

25. Record of Communication between Steve Yarbrough, former Field Investigation Team (FIT) team member during July of 1989, of CC Johnson, and Patrick Keller, of Morrison Knudsen, regarding July 1989 FIT field activities at the Basin School Yard site in Basin, Montana on August 22, 1994. Total pages: 1.

26. Jefferson County Assessors Office. Plat Map of Basin, Montana in Sections 17 and 18, T6N, R5W. Map of residential sample locations and Area B (Source 2) area of contamination for the Soil Exposure pathway, complied by TtEMI, July 8, 1999. Map: 1.

27. Memorandum to File from Sabrina Forrest, TtEMI, regarding Area B (Source 2) area of contamination calculation for the Soil Exposure Pathway, on June 23, 1999. Total pages: 2.

28. State of Montana, Bureau of Mines and Geology. 1960. Bulletin 16: Mines and Mineral Deposits (Except Fuels), Jefferson, County, Montana. Total pages: 17.

29. Montana Department of State Lands. 1995. Cultural Resource Inventory and Assessment for the Basin Mill, also known as the Glass Brothers Smelter. Total pages: 34.

30. Logbook of Hazard Ranking System Site Visit and scoring activities for the Basin Mining Area site, conducted by URSGWC and TtEMI on June 22, 1999. Logbook pages cover, 31-36, and 41. Entries made on June 22 and 25, 1999 and July 8, 1999. Total pages: 6.

31. US Department of the Interior, National Park Service. 1978. National Register of Historic Places Inventory--Nomination Form (draft) for Basin, Montana. Total pages: 11.

32. Stoughton, Bradley, and Butts, Allison, Engineering Metallurgy, A Textbook for Users of Metals, 1926. Total pages: 38.

33. Montana News Association. 1941. Various newspaper articles describing historic Basin, Montana. Total pages: 1.

34. Sanborn Map Company, Fire Insurance Maps for Basin, Jefferson County, Montana, for years 1896, 1904, 1912, and 1927. Total maps: 6.

35. US Environmental Protection Agency. 1994. Using Qualified Data to Document an Observed Release, Draft. Total pages: 14.

36. State of Montana, Official Highway Map. 1996-1997. Total maps: 1.

37. Reserved for future use.

38. Reserved for future use.

39. Abandoned Hardrock Mine Priority Sites Summary Report, Pioneer Technical Services, Inc., Engineering Services Agreement, Division of State Lands, Abandoned Mine Reclamation Bureau (DSL-AMRB) No. 004, Selected pages for mines in the Basin Creek drainage, Jefferson County, Montana, March 1994. Total pages: 45.

40. Abandoned Hardrock Mine Priority Sites Summary Report, Pioneer Technical Services, Inc., Engineering Services Agreement DSL-AMRB No. 94-006, Selected pages for mines in the Basin Creek drainage, Jefferson County, Montana, December 1994. Total pages: 28.

41. Abandoned Hardrock Mine Priority Sites Summary Report, Pioneer Technical Services, Inc., Engineering Services Agreement DEQ-AMRB No. 94-006, Selected pages for mines in the Basin Creek drainage, Jefferson County, Montana, June 1996. Total pages: 47.

42. Montana Bureau of Mines and Geology, Open-File Report No. 321, Abandoned-Inactive Mines Program, Deerlodge National Forest, Volume I, Basin Creek Drainage, April 1994. Total Pages: 86.

43. Reserved for future use.

44. Quality Assurance Project Plan for the Abandoned Mines Hazardous Materials Inventory , Pioneer Technical Services, Inc., June 1993. Total Pages: 5.

45. Sampling and Analysis Plan for the Abandoned Mines Hazardous Materials Inventory , Pioneer Technical Services, Inc., August 1993. Total Pages: 5.

46. US West, Telephone Directory for the Boulder-Basin, Montana area, 1999. Total pages: 6.

47. US Environmental Protection Agency (EPA). July 16-17, 1997. Photolog of the Basin Tailings Pile and the Jib Tailings Pile. Photos taken by Rosemary Rowe, EPA, on July 16-17, 1997. Total pages: 2.

48. US Environmental Protection Agency (EPA) Contract Laboratory Program Statement of Work for Inorganics Analysis, Document No. ILMO2.0, 1992. Total pages: 2.

49. Montana Department of State Lands, Abandoned Mine Reclamation Bureau, Hazardous Materials Inventory Site Investigation Log Sheet, Bullion Mine, Preliminary Assessment (PA) #22-008, July 6, 1993. Total pages: 32.

50. Montana Department of State Lands, Abandoned Mine Reclamation Bureau, Hazardous Materials Inventory Site Investigation Log Sheet, Buckeye-Enterprise Mine-Mill, PA#22-072 and PA#22-074, July 6, 1993. Total pages: 52.

51. Reserved for future use.

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54. Quality Assurance Project Plan for the Preliminary Screening of Mine Sites, Deerlodge National Forest, Montana Bureau of Mines and Geology, Open-File Report No. 259, December 1992. Total Pages: 36.

55. Reserved for future use.

56. US Geological Survey (USGS). 1998. Characterizing the Aquatic Health in the Boulder River Watershed, Outline Summary of Progress and Data Collected, 1997-1998. Draft. Total pages: 16.

57. Montana Fishing Regulations. 1998-1999. Central Fishing District. Total pages: 3.

58. Record of Communication between Terry Heaton of Basin School, and Kirk Eakin of URSGWC, regarding the 1999 address and attendance of the school. May 19, 1999. Total pages: 1.

59. Montana Fish Wildlife and Parks. 1999. Facsimile communication from Don Skaar, Montana Fish Wildlife and Parks, transmitting the fish population data for Basin Creek and the Boulder River. Total pages: 2.

60. Montana Department of Environmental Quality. 1998. Transmittal letter and partial inclusion of the Montana List of Waterbodies in Need of Total Maximum Daily Load (TMDL) Development. Draft. January 23, 1998. Total pages: 3.

61. Montana Department of State Lands, Abandoned Mine Reclamation Bureau, Abandoned Hardrock Mine Priority Sites, Data Validation and Evaluation Report, March 1994. Total pages: 3.

62. Montana Department of State Lands, Abandoned Mine Reclamation Bureau, Abandoned Hardrock Mine Priority Sites, Data Validation and Evaluation Report, December 1994. Total pages: 11.

63. Montana Department of State Lands, Abandoned Mine Reclamation Bureau, Abandoned Hardrock Mine Priority Sites, 1995 Data Validation and Evaluation Report, June 1996. Total pages: 3.

64. USGS. Science for Watershed Decisions on Abandoned Mine Lands: Review of Preliminary Results, Denver, Colorado, February 4-5, 1998. Total pages: 5

65. Memorandum of Phone Call between Dave Williams (EPA) and Don Skaar (Montana Fish Wildlife and Parks), regarding fishing and fish consumption in the Boulder River and Basin Creek in the vicinity of the Town of Basin, Montana. Total pages: 1.

General Site History

The area surrounding Basin, Montana is the site of extensive historical precious metal mining dating from the late 1800s (Ref. 18, p. 12). Processing of precious metal ore and deposition of tailings and mining waste rock took place at multiple locations within the Town of Basin, Montana, as well as at mines located in the Basin Mining Area (Ref. 18, p. 12; Figures 2-1 and 2-2). The Basin Mining Area is located in the Basin Mining District of the northeast part of the Deerlodge National Forest (Figure 2-1), and contains two main watersheds, Basin Creek and Cataract Creek; both tributaries of the Boulder River (Ref. 42, pp. 31, 33 ; Ref. 43, p. 40; Ref 6, p. 1).

The Basin Mining Area consists of abandoned and inactive hard rock mines where veins of quartz, tourmaline, pyrite, galena, tetrahedrite, sphalerite, arsenopyrite, chalcopyrite, and siderite within the Cretaceous Boulder Batholith were explored. The veins were lode mined for their silver and base metal content, although some also contained gold (Ref. 42, p. 34). Lode mining of lead-silver and gold ores in the Basin Mining District began in the 1870s, reached a peak between 1895 and 1903, and ended around 1907; after which mines such as the Crystal, Bullion, Hope, Katie, and Katie Extension mines were further developed (Ref. 18, p. 12). From 1902 to 1957, the area produced gold (129,040 ounces (oz.), silver (5,603,300 oz.), copper (4,237,522 pounds (lbs.), lead (35,293,697 lbs.), and zinc (27,201,179 lbs.); however, activity on Basin Mining Area properties has been minimal since the forties (Ref. 42, p. 26, 31-34).

In general, mills were usually located adjacent to the mine and produced two materials: 1) a commodity product or concentrate needing further refinement, and 2) waste, or tailings (Ref. 42, p. 28). Most mills of the 1800s treated ore by crushing or grinding; then the ore required concentration, either by gravity or flotation methods (Ref. 42, p. 28). The high-sulfide ores required gravity or flotation milling to concentrate the metals and the concentrates were usually smelted to recover the metal (Ref. 32, pp. 10, 11; Ref. 42, pp. 13, 23, 34). Both mine dumps and tailings in the Basin Mining Area usually have abundant pyrite and significant metal content, and can be sources of contamination (Ref. 42, pp. 25, 34). Metals are often transported from a mine by water (ground water discharges or surface runoff) either by being dissolved, suspended, or carried as part of the bedload. When sulfides are present, acid can form, which, in turn, increases the solubility of metal. This condition, known as Acid Mine Drainage (AMD), is a significant source of metal releases at many of the mines in Montana (Ref. 42, pp. 12, 13).

The U.S. Department of the Interior National Register of Historic Places Inventory Nomination Form indicates that about 400 mining claims were staked in the mountains surrounding Basin and were developed to some degree (Ref. 31, p. 9). According to the Montana Bureau of Mines and Geology, Abandoned-Inactive Mines Program (AIM) report for the Deerlodge National Forest, the Basin Creek Drainage consisted of 39 mines; 14 of which were identified as having a potential to contribute to environmental degradation (Ref. 42, pp. 36). The Montana Dept of State Lands, Abandoned Mine Reclamation Bureau, (MDSL AMRB), currently known as the Department of Environmental Quality, Mining Waste Control Board, completed a Hazardous Materials Inventory Site Investigation in which 12 mines were documented in the Basin Creek Drainage with the greatest potential threats to human health and safety and the environment (Ref. 39, pp. 6, 14; Ref. 40, pp. 3, 7-9, 19-20; Ref. 41, pp. 4, 6-8 42).

Some of the mines that contribute to the metals releases in Basin Creek and the Boulder River downstream of the Basin Creek confluence are the Buckeye-Enterprise mine-mill, the Bullion mill, the Bullion smelter, the Daily West mine, the Hector mine, the Lower Hector mine, and the Basin Belle mine Ref. (Ref. 42, pp. 36-37). The Bullion mine and Buckeye-Enterprise mine in the Basin Creek drainage, and the Crystal mine in the Cataract Creek drainage appear to be major contributors to the dissolved-metals loading in the creeks (Ref. 42, p. 38). The group of mines in the Jack Creek drainage, a tributary to Basin Creek, have the greatest individual and collective impact of any other mines in the Basin and Cataract Creek drainages (Ref. 42, p. 38). These mines are located upstream of the Town of Basin and the Boulder River (Ref. 42, pp. 32, 33; Ref. 6). Several other mines were determined to contribute to the metals releases in Cataract Creek and the Boulder River downstream of the Cataract Creek; however, the Cataract Creek drainage was not evaluated for this Hazard Ranking System Documentation Record (HRSDR).

Of the Basin Mining Area lode mines, the Bullion, Crystal, Hope, Katie, and Katie Extension mines yielded most of the ore mined in the area (Ref. 18, p. 12). In the Town of Basin, one of the most productive mines was the Jib Mill/Hope-Katie Mine Complex (Ref. 31, p. 9). Between 1890-1910, the Hope and Katie mines (i.e., Jib Mill Complex) produced $5,000,000 in mineral wealth (Ref. 31, p. 9). Within Sections 17 and 18, Township 6 North, Range 5 West, of Basin, there were 15 patented mining claims associated with the Jib or Hope-Katie Mine (Ref. 28, p. 11). Sanborn maps show that the Jib Mill Complex was also known as Basin Reduction Company, the La France Copper Company, and Jib Consolidated Mining Company (Ref. 34, pp. 3, 4, 5; Ref. 29, p. 14). In 1917, the Jib Mining Company reopened the Katie Mill concentrator and it became known as the Jib Mill (Ref. 29, pp. 14, 17). In 1923, a 300-ton mill equipped for gravity concentration and flotation was constructed (Ref. 28, p. 11; Ref. 29, p. 17). In 1933, Roy E. Miller, Inc. took over the property, overhauled the mill, and re-worked 48,300 tons of tailings by flotation (Ref. 28, p. 12). In 1953, the property was also open-pit mined by Basin-Jib Gold Mines, Ltd. (Ref. 28, p. 12). The mill burned down in 1975 (Ref. 31, p. 6).

The East Katie mine is described as being located on the north side of the Boulder River at Basin almost opposite the Hope-Katie or Basin Jib mine (Ref. 28, p. 9). The East Katie vein was part of the Hope-Katie lode that had been displaced about 800 feet north due to faulting (Ref. 28, pp. 9, 12). The property was developed in 1929 by a 200-foot shaft and in 1955 the shaft was extended. Production information, which may have been credited to the Basin Jib mine, may have actually come from the East Katie mine (Ref. 28, p. 9). The exact location of the East Katie mine has not been determined; however, the topographic map shows the location of a mine shaft north of the Boulder River at the location of the Basin Tailings Pile (Ref. 6). This corresponds to the location of an historic head frame currently located on the Basin Tailings Pile (Ref. 47, p. 1) and may represent the East Katie Mine shaft.

The Basin Mining Area, includes characterized mines within the Basin Creek Drainage, mining wastes on both sides of the Boulder River adjacent to the Town of Basin, and the Boulder River (Ref. 6, p. 1). The mines in the Basin Mining Area and surrounding Boulder River tributaries have negatively affected the water quality in the Boulder River (Ref. 64, p. 5). Annual loads of metals from Basin Creek, Cataract Creek (located approximately 1 mile downstream of Basin Creek [Ref. 6]), and High Ore Creek (located approximately 4 miles downstream of Basin Creek [Ref. 6]), as well as two mine sites on the Boulder River located upstream and downstream of these creeks were evaluated by the U.S. Geological Survey (USGS) (Ref. 64, p. 5). Water quality data collected from 1989 to 1996 (12 sample sets) indicated that although Basin, Cataract, and High Ore creeks contributed 33 percent of the annual streamflow, these Boulder River tributaries contributed 41-89 percent of the cadmium, copper, lead, and zinc loads; Cataract Creek contributed the largest load of these metals (Ref. 64, p. 5).

Visual observations of tailings and waste rock in contact with Basin Creek were made during the 1994 and 1995 MBMG investigations, as well as the 1993 and 1994 MDSL investigations (Ref. 39, pp. 38-39; Ref. 42, pp. 54-55; Ref. 49, pp. 1, 6-8, 11; Ref. 50, pp. 7-8, 11-12, 36). These and EPA investigations that have taken place within the Basin Mining Area support the presence of hazardous substances related to historic mining practices in tailings, waste rock, and residential and school soils (Ref. 3, pp. 35-38, 80-84, 86-89, 94-95; Ref. 5, pp. 34, 36, 63; Ref. 8, p. 25; Ref. 17, p. 67, Ref. 25, p. 1; Ref. 39, pp. 31, 36-39; Ref. 41; Ref. 42, pp. 44, 59; Ref. 49, pp. 5, 7-8, 18; Ref. 50, pp. 6, 9, 33, 35). The same investigations also document the presence of hazardous substances in sediment, surface water, and fish organ samples collected from Basin Creek and the Boulder River (Ref. 3, pp. 31, 37; Ref. 5, pp. 14, 31, 33; Ref. 8, pp. 22, 25, 26; Ref. 17, pp. 4, 5, 60, 61, 63; Ref. 25, p. 1; Ref. 24; Ref. 39, pp. 36, 38, 39; Ref. 50, pp. 5, 11, 37, 43).

SOURCE DESCRIPTION

2.2 Source Characterization

Number of the source: 1

Name and description of the source: Basin Tailings Pile

The area surrounding Basin, Montana is the site of extensive historical precious metal mining dating from the late 1800s (Ref. 18, p. 12). Processing of precious metal ore and deposition of tailings took place at multiple locations within the Town of Basin, Montana. The largest of these tailings piles were characterized by chemical analyses during the EPA investigation in 1989. The tailings pile that has been characterized by chemical analysis and constitutes Source 1 is the Basin Tailings Pile (Ref. 5, pp. 19-21, Ref. 47, pp. 1-2).

The East Katie mine is described as being located on the north side of the Boulder River in the Town of Basin almost opposite the Hope-Katie or Basin Jib mine (Ref. 28, p. 9; Ref. 18, p. 12). The East Katie vein was part of the Hope-Katie lode that had been displaced about 800 feet north due to faulting (Ref. 28, pp. 9, 12). The property was developed in 1929 by a 200-foot shaft and in 1955 the shaft was extended. Production information that was credited to the Basin Jib mine, may have actually come from the East Katie mine (Ref. 28, p. 9). The exact location of the mine has not been determined; however, the topographic map shows the location of a mine shaft north of the Boulder River at the location of the Basin Tailings Pile (Ref. 6). Therefore, EPA considers that the East Katie Mine could have contributed to the Basin Tailings Pile (Source 1).

The 1989 EPA investigation reported a head frame and large tailings pile (aka Basin Tailings pile) readily visible from I-15 (Ref. 5, p. 6; Ref. 47, p. 1). The Basin Tailings Pile measures approximately 300 feet wide from east to west. The tailings are tan to yellow in color and show evidence of erosion (Ref. 5, p. 6; Ref. 7; Ref. 47, p. 1). Observations of Source 1 were made during the EPA site visit on June 2, 1999 to verify that tailings are uncontained and available to the environment via runoff and potentially through aerial deposition from high winds (Ref. 30, p. 3, 6; Ref. 47, p. 1).

Location of the source:

Source 1 consists of the Basin Tailings Pile that is located in the small, rural Town of Basin, Montana. Basin, Montana is located in Section 17 and 18, Township 6 North, Range 5 West, in Jefferson County, Montana (Ref. 6, p. 1). The Basin Tailings Pile is situated in the northwest part of the Town of Basin approximately 230 feet north of Basin Street (Ref. 4, p. 18; Ref. 47, p. 1; Ref. 6; Ref. 7). Source 1 is identified as the "Washington Lode (unsurveyed)" on the Basin, Montana plat map (Ref. 26).

Containment

Gas/particulate release to air: The air migration pathway was not scored as part of this HRS documentation record.

Release to ground water: The ground water migration pathway was not scored as part of this HRS documentation record.

Release via overland flow and/or flood migration: A containment factor value of 10 is assigned for the surface water migration pathway because no maintained engineered cover or functioning and maintained run-on control and runoff management system is known to be in place at the Basin Tailings Pile (Ref. 1, p. 51609, Table 4-2; Ref. 14, p. 7; Ref. 47, p. 1). The Boulder River is located about 600 feet south (downstream) and Basin Creek is located about 1,000 feet east of the Basin Tailings pile (Ref. 6; Ref. 7, pp. 1-2; Ref. 26).

2.4.1 Hazardous Substances

The hazardous substances detected from chemical analysis of source sample BM-SO-3 collected during EPA's Screening Site Inspection (SSI) from the Basin Tailings Pile was used to characterize Source 1 (Ref. 5, p. 15, 12, 20; Ref. 8, pp. 23, 25).

Hazardous Substance	Evidence (Sample Station, concentration in ppm)		Reference
Arsenic	Station BM-SO-3 (MHL947)	79.1	5, p. 34; 8, p. 25; 17, p. 67; 25, p. 1
Copper	Station BM-SO-3 (MHL947)	195	
Lead	Station BM-SO-3 (MHL947)	1310 B	
Manganese	Station BM-SO-3 (MHL947)	31.8	
Silver	Station BM-SO-3 (MHL947)	4.3	
Zinc	Station BM-SO-3 (MHL947)	49.2	

B Detected in laboratory blank. Quantity reported is greater than 5 times the quantity detected in the blank (Ref. 5, p. 35; Ref. 17, p. 75)

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

Hazardous Constituent Quantity Value (S): NE

2.4.2.1.2 Hazardous Wastestream Quantity

Hazardous Wastestream Quantity Value (W): NE

2.4.2.1.3 Volume

Volume Assigned Value: NE

NE = Not Evaluated

2.4.2.1.4 Area

The area of the Basin Tailings Pile was calculated by digitizing the delineated, obvious extent of the tailings pile depicted on a 1979 aerial photograph. The approximate scale of the aerial photograph is 1 inch to 500 feet (Ref. 7, p. 1).

Area of Basin Tailings Pile (square feet): 26,151

The Area Assigned Value is calculated by dividing the area of Source 1 by the area divisor for a waste pile which is 13 (Ref. 1, Table 2-5).

Calculations:

$$26{,}151 \div 13 = \text{Area Assigned Value} = 2{,}011.62$$

Area Assigned Value: 2,011.62

Source Hazardous Waste Quantity Value: 2,011.62

SOURCE DESCRIPTION

2.2 Source Characterization

Number of the source: 2

Name and description of the source: Contaminated Soil

Residential soils in the Town of Basin, Montana, including soil at the Basin School, have been documented to contain site attributable hazardous substances at concentrations that are significantly greater than the background concentrations (Ref. 3, pp. 9-10, 20, 36-38, 78-97; Ref. 2, pp. B-65, B-6; Ref. 5, pp. 21, 63; Ref. 8, p. 13; Ref. 17, pp. 58-115; Ref. 25, p. 1). Soil samples were collected from residential properties and the Basin School Yard in the Town of Basin during EPA investigations conducted in July of 1989 and August of 1991 (Ref. 4, pp. 4-5, 11; Ref. 8, p. 5). Soil samples were collected at the residences known in 1991 as Goodwin, Jackson, Wagner, and Beadles (Ref. 3, pp. 10, 25-29). The rural route addresses of the homes and some ownership information has changed since the 1991 Expanded SI (Ref. 13, p. 1; Ref. 22; pp. 1-12).

Available Sanborn maps from 1896, 1904, 1912, and 1927 show that the prevailing winds in Basin are from the southwest, i.e., from the Jib Tailings Pile and the Basin Tailings Pile, toward the Town of Basin (Ref. 34, pp. 1, 2, 4, 5). The valley in which the Town of Basin lies is only 0.1 to 0.5 miles wide to the base of the mountains on the north and south sides of the valley (Ref. 6). Wind-blown distribution of emissions and metal-laden particulates from the various mills and uncontained tailings piles in the Basin area may have contributed to contaminated soils in Source 2 (Ref. 30). In addition, the State of Montana has indicated that fill material may be the source of the contamination in the Basin School playground soils (Ref. 21, p. 1).

Location of the source:

The area of contaminated soil is located in the northwest section of the Town of Basin, Montana and is depicted on the city plat map (Ref. 26, p. 1). The school and residential house locations are described in the following table (Ref. 13, pp. 1-2).

Former Name/Address (1991)	Present owner/address (1999)	Legal - Block, and Lot
Goodwin/102 N. Quartz Street	Goodwin/17 Quartz Ave.	Basin Townsite - Block 1, E 72 Ft of Lot 2
Jackson/108 N. Quartz	Scoville/21 Quartz Ave.	Basin Townsite - Block 1, Amended Lot 4A
Basin School/119 N. Quartz	Basin School/30 Quartz Ave.	Basin Townsite - Block 16, Lots 7, 8, & 9
Wagner/3 N. Evans Street	Hale/4 N. Evans Street	Basin First Addition - Block 3, North 35 ft. of Lot 7 and Lot 8 (less E 7.5 of S 65 ft)
Beadles/5 N. Evans Street	Wegener/6 N. Evans Street	Basin First Addition - Block 3, Lots 9 & 10

The area of contaminated soil is identified as the triangular shape delineated by samples collected at the Basin School and residences within the northwest section of Basin, Montana (Ref. 26, p. 1). The Basin School sample location is identified as BM-SO-8 (Ref. 5, p. 36). The residential sample locations are identified as BS-9-2, BS-9-9, BS-11-4, BS-15-2, BS-15-4, BS-15-5, and BS-15-7 (Ref. 4, pp. 11-12; Ref. 13, pp. 1-2; Ref. 22, pp. 4, 7, 10; Ref. 26, p. 1).

Containment

Gas/particulate release to air: The air migration pathway was not scored as part of the HRS documentation record.

Release to ground water: The ground water migration pathway was not scored as part of the HRS documentation record.

Release via overland flow and/or flood migration: The contaminated soil does not have a maintained cover, liner, or runon/runoff controls (Ref. 1, p. 51609, Table 4-2; Ref. 3, p. 9-10; Ref. 14, p. 7; Ref. 30, p. 4). A containment factor value of 10 is assigned for the surface water migration pathway (Ref. 1, Table 4-2).

2.4.1 Hazardous Substances

Sample BM-SO-8 (MHL952) was collected from the southwest playground of the Basin School, which is located within the fenced part of the school's property (Ref. 8, pp. 23, 25; Ref. 16, p. 1; Ref. 25, p. 1). Arsenic and lead were detected in the schoolyard sample at elevated concentrations (Ref. 2, p. 65; Ref. 5, pp. 34, 36, 56, 63). Residential soil samples were collected within 200 feet of the residence and within the property boundaries (Ref. 3, p. 9). Analytical results from soil sample analyses indicate that arsenic, cadmium, copper, lead, and mercury were detected in concentrations that are significantly greater than the background concentrations (Ref. 3, pp. 35-38, 80, 83, 84-86, 90, 94-95; Ref. 5, pp. 34, 36, 56, 63).

Sample ID	Sample Location (Legal Description)	Depth	Date	Reference
BM-SO-8/ MHL952	Basin School Yard on playground and within 200 feet of school building	Surface	7/14/89	3, pp. 30-31 5, p. 15; 8, pp. 23, 25; 16, p. 1; 25, p. 1; 4, pp. 11-12, 18-25, 35-36; 14, pp. 36,40, 42; 13, pp. 1-2
BS-11-4/ MHT753	Goodwin residence, southwest	0-6"	8/1/91	
BS-15-2/ MHT754	Wagner residence, south	0-6"	8/1/91	
BS-15-4/ MHT755	Wagner residence, north	0-6"	8/1/91	
BS-15-5/ MHT756	Beadles residence, northeast	0-6"	8/1/91	
BS-15-7/ MHT757	Beadles residence, north	0-6"	8/1/91	
BS-9-2/MHT766	Jackson residence, east	0-6"	8/1/91	
BS-9-9/MHT765	Jackson residence, south	0-6"	8/1/91	

Hazardous Substance	Evidence (Sample Station, concentration in ppm)		SQL (ppm)	Reference
Arsenic	BM-SO-8/MHL952	990	505	5, pp. 36, 63; 3, pp. 35-38, 80, 83-86, 94-95; 24, pp. 1, 2, 6, 7
Cadmium	BM-SO-8/MHL952	10.9	1.01	
Copper	BM-SO-8/MHL952	913	5.05	
Lead	BS-11-4/MHT751	804	2.21	
Mercury	BS-11-4/MHT751	0.75 J	0.18	
Lead	BS-15-2/MHT 754	863	0.57	
Lead	BS-15-4/MHT755	4,980	0.70	
Mercury	BS-15-5/MHT756	2.2 J	0.20	
Lead	BS-15-7/MHT757	1,600	0.62	
Lead	BS-9-2/MHT766	385	1	
Lead	BS-9-9/MHT765	1,840	0.62	

J The associated numerical value is an estimated quantity because the Quality Control criteria were not met (Ref. 3, pp. 77, 80, 85).

ppm Parts per million

SQL Sample Quantitation Limit

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

Hazardous Constituent Quantity Value (S): NE

2.4.2.1.2 Hazardous Wastestream Quantity

Hazardous Wastestream Quantity Value (W): NE

2.4.2.1.3 Volume

Volume assigned value: NE

NE = Not Evaluated

2.4.2.1.4 Area

Soil samples collected from four residences and the Basin School indicate the presence of hazardous substances at levels significantly above background (Ref. 1, Table 2-3, p. 51589). The contaminated soil area can be delineated from the approximate documented locations of the eight samples used to define the area of the observed contamination (Ref. 4, pp. 11-12; Ref. 5, p. 36). The area of soil contamination covers an expanse of approximately 179,449 square feet (Ref. 26, Ref. 27).

Area Assigned Value (square feet) = 179,449 ft^2

179,449 $ft^2 \div 34{,}000$ = Area Assigned Value = 5.28 (rounded)

To calculate the Area Waste Quantity Value, the Tier D, Contaminated Soil Measure will be used; the divisor for contaminated soil is 34,000 (Ref. 1, Table 2-5).

Area (square feet): 179,449 ft^2
Area Assigned Value: 5.28

Source Hazardous Waste Quantity Value: 5.28

SOURCE DESCRIPTION

2.2 Source Characterization

Number of the source: 3

Name and description of the source: Bullion and Buckeye-Enterprise Mines in the Basin Creek Drainage

Source 3 consists of the following mines in the Basin Creek drainage: 1) the Bullion mine, located on a tributary of Jack Creek, approximately 3 miles upstream of the Jack Creek and Basin Creek confluence, and 2) the Buckeye-Enterprise mine-mill, located near the headwaters of Basin Creek (Ref. 42, p. 22; Ref. 6). The two mines' tailings piles, waste rock, and adit discharges were characterized by chemical analyses and are evaluated as Source 3 (Ref. 6).

Source 3 is part of the Basin Creek drainage portion of the Basin Mining Area. This area consists of abandoned and inactive hard rock mines where veins of quartz, tourmaline, pyrite, galena, tetrahedrite, sphalerite, arsenopyrite, chalcopyrite, and siderite within the Cretaceous Boulder Batholith were explored. The veins were mined for their silver and base metal content, although some also contained gold (Ref. 42, p. 34). From 1902 to 1957, the Area produced gold (129,040 ounces (oz.)), silver (5,603,300 oz.), copper (4,237,522 pounds (lbs.)), lead (35,293,697 lbs.), and zinc (27,201,179 lbs.) (Ref. 42, pp. 31-34).

According to the MBMG, Abandoned-Inactive Mines Program (AIM) report for the Deerlodge National Forest, the Basin Creek drainage consisted of 39 mines; 14 of which were identified as having potential to contribute to environmental degradation (Ref. 42, pp. 36). The MDSL /AMRB, (currently known as the DEQ, MWCB), documented 12 mines in the Basin Creek Drainage with the greatest potential threats to human health and safety and the environment. These mines are located upstream of the Town of Basin and the Boulder River (Ref. 6).

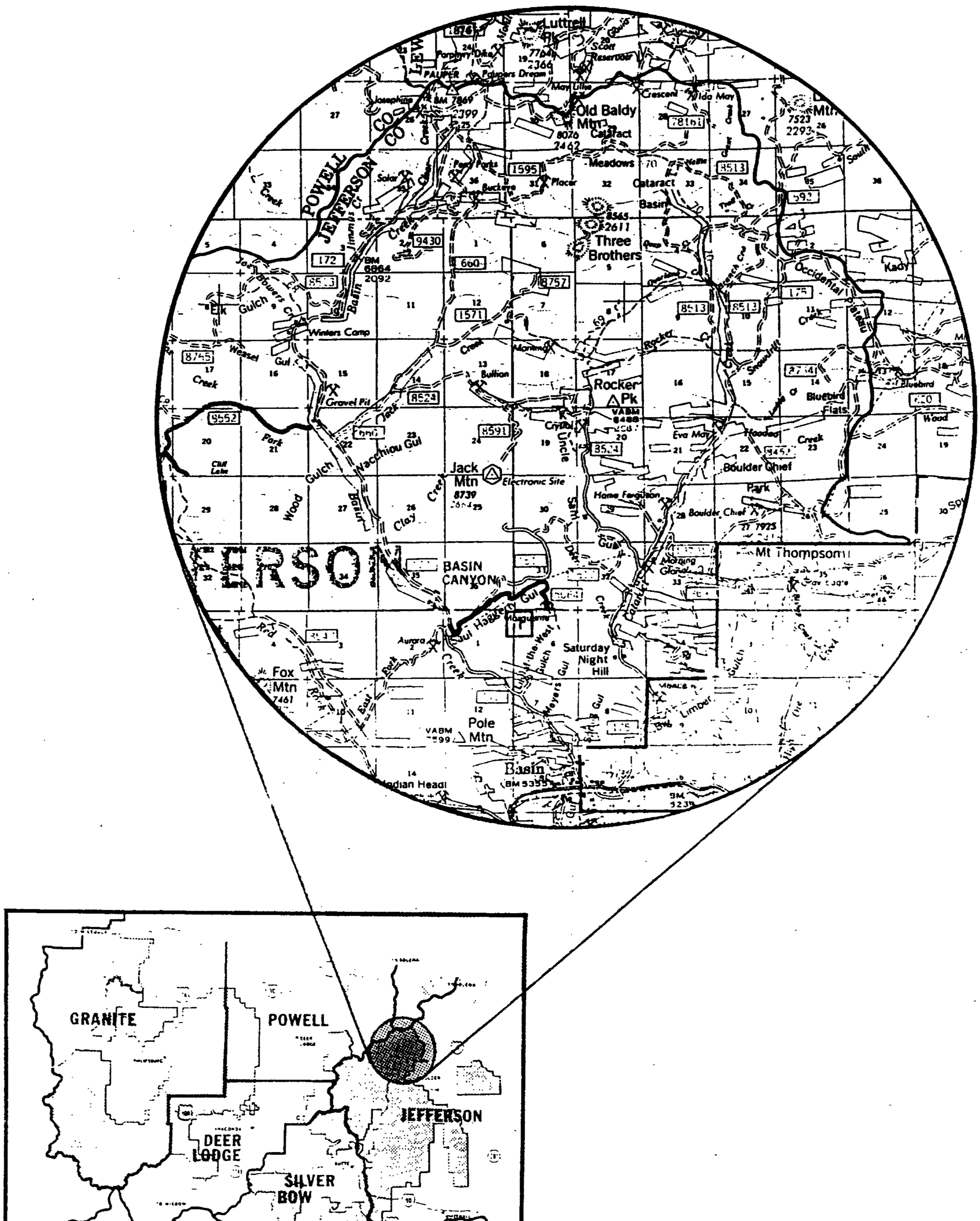


FIGURE 2
BASIN - CATARACT
CREEK DRAINAGE

Figure 2-1

Figure 3
Abandoned-Inactive Mines – Basin Creek Drainage

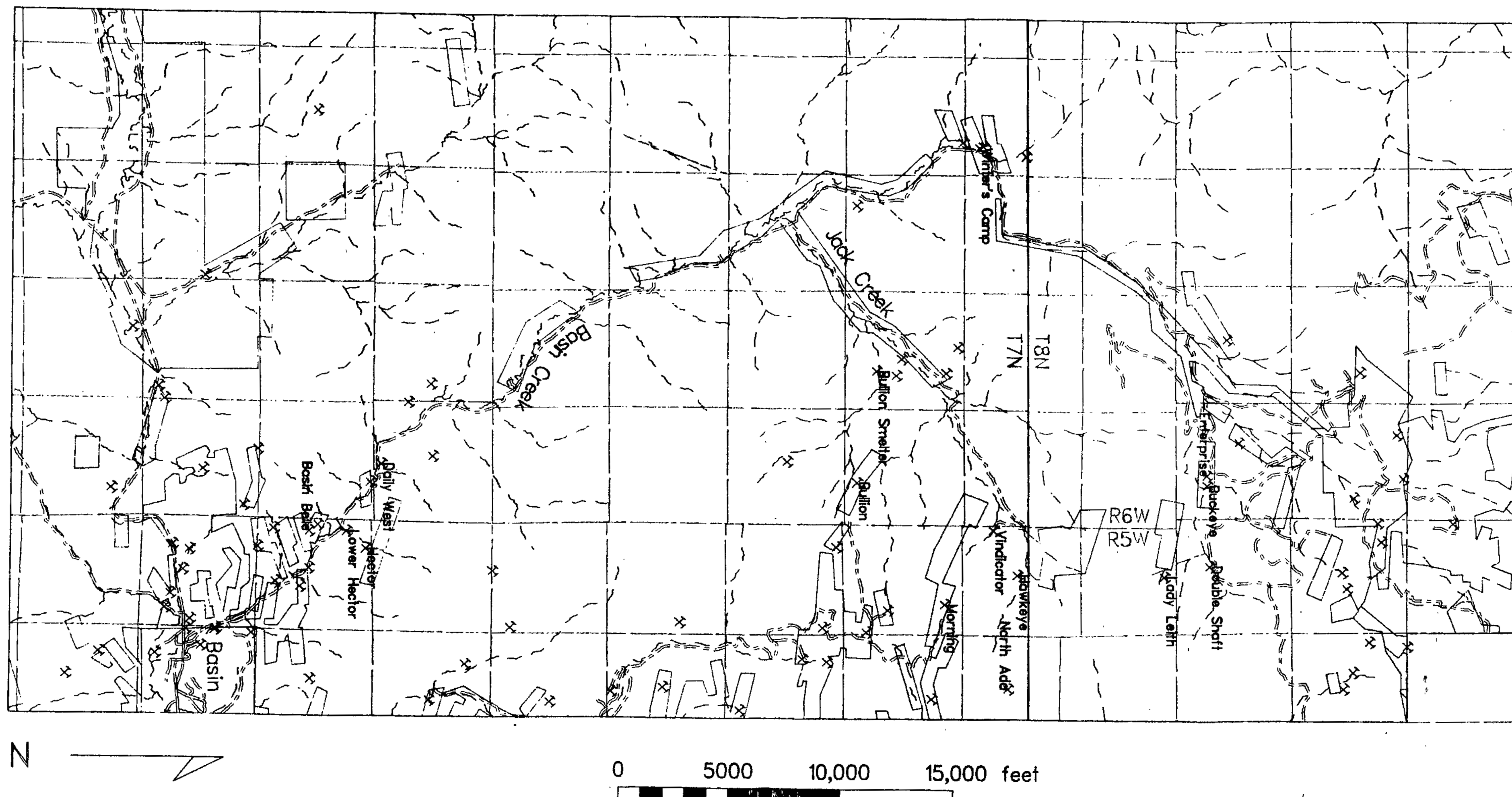


Figure 2-2

Bullion Mine

The Bullion was the largest and most productive abandoned/inactive mine in the area; it was worked periodically from 1905 to 1955 (Ref. 49, p. 3). In 1905, a 150-ton per day (tpd) concentrator was installed at the Bullion mine and a smelter was installed one mile down the road toward Jack Creek (Ref. 41, pp 25-26; Ref. 49, p. 3). The area of disturbed lands is approximately 10 acres (Ref. 49, p. 2). Bullion mine tailings comprise about 4,200 cubic yards; waste rock comprises about 42,150 cubic yards (Figure 2-3) (Ref. 39, p. 30; Ref. 49, pp. 7-8).

The Bullion mine development area consists of several disturbed areas on two separate, unnamed tributaries to Jack Creek (Ref. 42, pp. 40, 42; Ref. 6, p. 1; Ref. 49, pp. 4, 5). The smelter area is located approximately 1.5 miles upstream of the confluence of Jack Creek and Basin Creek (Ref. 42, p. 40) and the main development area is approximately 3 miles upstream of the Jack Creek and Basin Creek confluence (Ref. 6, p. 1).

Buckeye-Enterprise Mine-Mill

The Buckeye and Enterprise mines were worked as one gold mining operation for a period of time and both mines used the Buckeye gravity mill facility. Both were operated intermittently from the late 1890s to 1908 (Ref. 42, p. 54; Ref. 50, p. 3). The Buckeye also operated during the 1940s and a flotation mill was added to re-treat the gravity tailings (Ref. 42, p. 54). The gold mining operation involved gravity and flotation milling, which produced ore yielding gold, silver, copper, lead, and zinc (Ref. 50, p. 3). The 1994 Hazardous Materials Inventory Site Investigation (HMISI) report indicates that the Buckeye includes three collapsed adits and the Enterprise includes one collapsed adit (Ref. 50, pp. 3, 28).

The Buckeye-Enterprise mine-mill occupies 10 acres (9-acres Buckeye/1-acre Enterprise) and is located near the headwaters of Basin Creek (Figures 2-1, 2-2) (Ref. 50, pp. 2, 3, 27, 28; Ref. 42, p. 54). The 1994 HMISI report noted that Buckeye mining wastes were in contact with surface water (Ref 1, Table 4-2, p. 51609; Ref. 50, pp. 7, 9, 11). The HMISI also noted that at Enterprise, the mine workings were caved, discharge issued from the Enterprise adit, and the waste rock and tailings were in contact with Basin Creek (Ref. 50, pp. 11-12, 36; Ref. 39, pp. 38-39; Ref. 42, pp, 54-55).

The Buckeye-Enterprise mine-mill tailings consisted of coarse sands to fine clays (Ref. 50, p. 7). Tailings at the Buckeye comprise about 20,750 cubic yards; no tailings were noted at the Enterprise. Waste rock at the Buckeye comprise 6,130 cubic yards and at the Enterprise comprise 22,930 cubic yards (Ref. 50, p. 6).

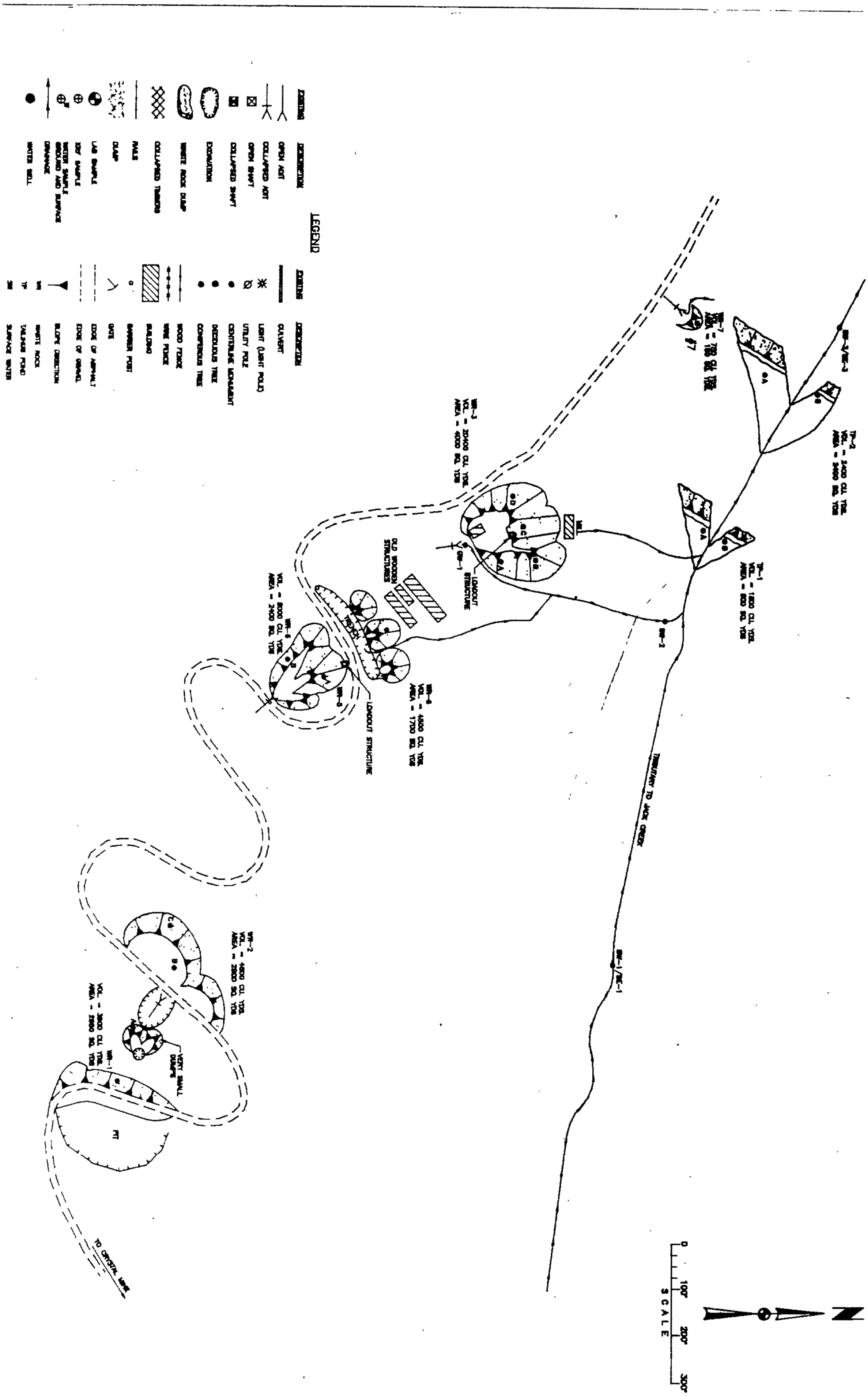


Figure 2-3

22-008.DWG SHEETS

MONTANA DEPT. OF STATE LANDS HAZARDOUS MATERIAL INVENTORY	PIONEER	DRAWN MWC DATE 8/93 DESIGNED TPR JOB NO. 93-17 APPROVED F.B. NO.
BULLION MINE & MILL PA #22-008 BASIN DISTRICT JEFFERSON COUNTY	TD&H	THOMAS, DEAN & HOSKINS INC. ENGINEERING CONSULTANTS GREAT FALLS–BOZEMAN–KALISPELL MONTANA SPOKANE WASHINGTON

SHEET NO.

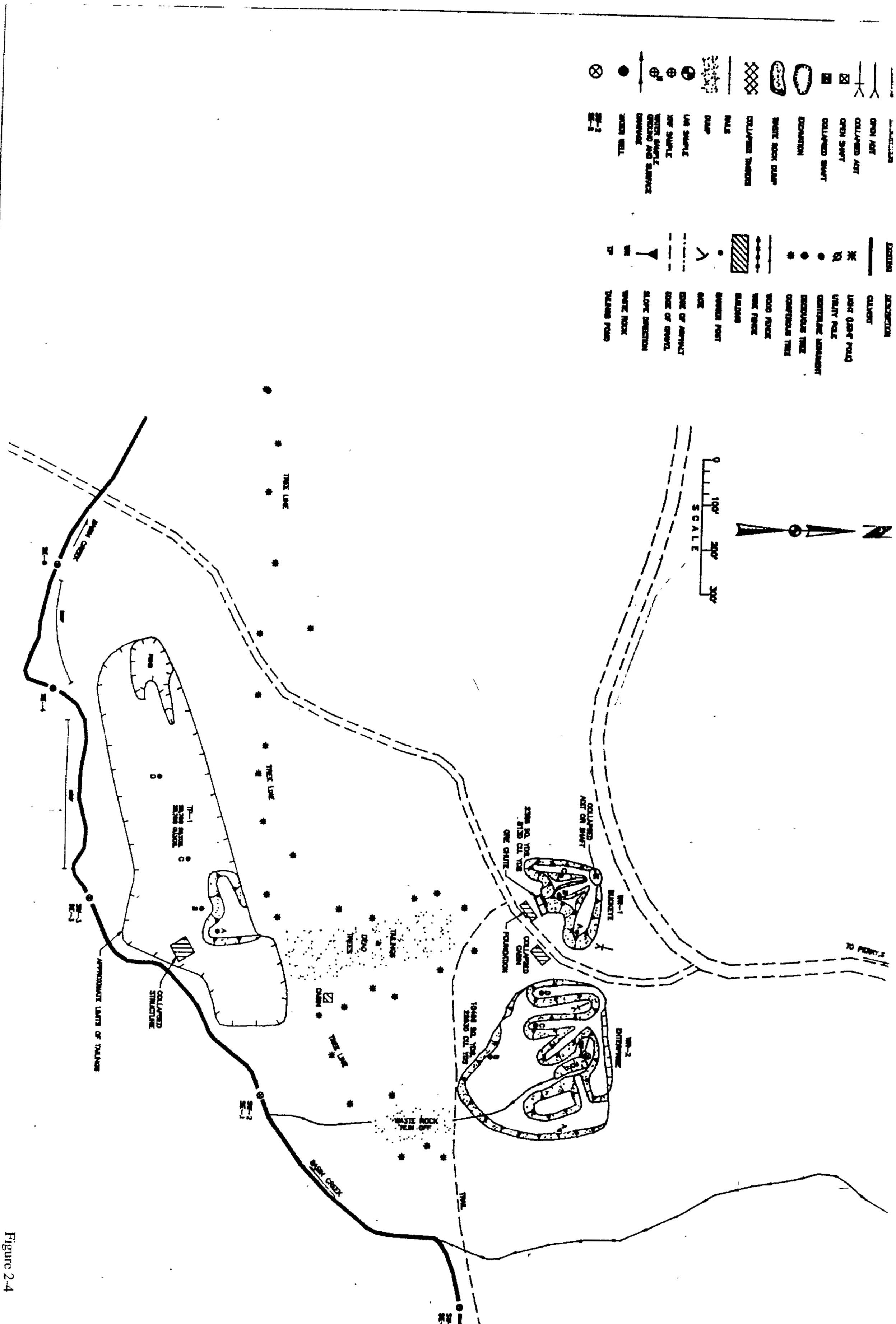


Figure 2-4

MONTANA DEPT. OF STATE LANDS HAZARDOUS MATERIAL INVENTORY	PIONEER	DRAWN MMC DATE 9/93 DESIGNED TPR JOB NO. 93-17 APPROVED F.B. NO.
BUCKEYE & ENTERPRISE PA# 22-072 & 074 BASIN DISTRICT JEFFERSON COUNTY	TD&H	THOMAS, DEAN & HOSKINS INC. ENGINEERING CONSULTANTS GREAT FALLS-BOZEMAN-KALISPELL MONTANA SPOKANE WASHINGTON

SHEET NO.

Location of the source:

The Bullion mine is located in the southwest of the southeast quarters of S 13, T 7N, R 6W. The Bullion includes four caved adits, three pits (two large), tailings ponds, and waste rock (Figure 2-3).

The Buckeye-Enterprise mine-mill is located in the northwest of the southeast quarters of S 36, T 8N, R 6W (Figures 2-2, 2-4) (Ref. 6).

Containment:
Gas/particulate release to air: The air migration pathway was not scored as part of this HRS documentation record.

Release to ground water: The ground water migration pathway was not scored as part of this HRS documentation record.

Release via overland flow and/or flood migration: A containment factor value of 10 is assigned for the surface water migration pathway. No maintained engineered cover or functioning and maintained run-on control and runoff management system is known to be in place at any of the mine tailings piles and waste rock piles that constitute Source 3 (Ref. 1, Table 4-2; Ref. 49, pp. 1, 6-8, 11;Ref. 50, pp. 7-8, 11, 36).

2.4.1 Hazardous Substances

Background data for the Montana Department of State Lands, Abandoned Mine Reclamation Bureau (MDSL/AMRB), (currently known as the Montana Department of Environmental Quality (DEQ), Mine Waste Cleanup Bureau), HMISI log sheets were compiled for soils, ground water, surface water, and sediments. Background samples were collected from proximal areas and from soils within similar geologic units to establish the extent to which metals concentrations were elevated in comparison to the local background (Ref. 39, p. 24; Ref. 40, p. 16; Ref. 41, p. 15).

The hazardous substances detected in source samples collected from the waste piles within the Basin Creek Drainage were used to characterize Source 3. Source samples were collected from the Bullion mine and the Buckeye-Enterprise mine-mill during the MDSL/AMRB investigation conducted in 1993 and 1994 (Ref. 39; Ref. 40; Ref. 41) and during the MBMG Abandoned-Inactive Mines Program investigation (Ref. 42, pp. 18-25, 38-39, 44, 46, 52, 59, 60, 65, 69, 72, 74,77). The analytical results from the samples collected at the Bullion mine and the Buckeye-Enterprise mine-mill are summarized in the following tables (Figures 2-3, 2-4) (Ref. 49, pp. 5, 7-8, 18; Ref. 50, pp. 6, 9, 33, 35, 43).

Bullion Mine Source Samples

Sample ID	Hazardous Substance	Concentration (mg/kg)	DL (ppm)	Reference
Tailings* 22-008-TP-1 22-008-TP-2 22-008-TP-3	Arsenic Cadmium Copper Lead Mercury Antimony	2440 - 4470 2.9 172 - 257 3330 J - 5110 J 0.373 J - 0.575 J 151 - 196	2 1 5 0.6 0.04 12	39, pp. 18, 22, 31; 49, pp. 5, 7-8, 18; 23; 48
Waste Rock** 22-008-WR-1 22-008-WR-2	Arsenic Cadmium Copper Lead Mercury Antimony Zinc	1690 J - 18100 J 4.1 J 137 - 372 3610 J - 11300 J 0.383 J - 0.519 J 66 - 254 695	2 1 5 0.6 0.04 12 4	39, pp. 18, 22, 31; 49, pp. 5, 7-8, 18 23; 48
Upper Soils Wash Area BBUD10H	Arsenic Cadmium Copper Lead Zinc	7835 8.9 309 5.56 1937	2 1 5 0.6 4	42, pp. 22, 44; 49, pp. 5, 7-8, 18; 23; 48
Tailings Wash Area BBUD20H	Arsenic Cadmium Copper Lead Zinc	794 1.3 49.2 504 86.6	2 1 5 0.6 4	42, pp. 22, 44; 23; 48

DL Detection Limit
J Estimated Quantity
ppm Parts per million; equivalent to mg/kg
Notes: * Tailings sample 22-008-TP-1 is a composite of TP-1A-A through TP-1A-C, and TP-1B-A and TP-1B-B. Sample 22-008-TP-2 is a composite of TP-2A-A, TP-2A-B, TP-2B-A, and TP-2B-B. Sample 22-008-TP-3 is a composite of TP-1A-D, TP-2A-C, and TP-2B-C.
** Waste rock sample 22-008-WR-1 is a composite of WR-2B, WR-2C, and WR-3B. Sample 22-008-WR-2 is a composite of WR-5A, WR-5B, and WR-3D.

Buckeye-Enterprise Mine-Mill Source Samples

Sample ID	Hazardous Substance	Concentration (mg/kg)	DL (ppm)	Reference
Tailings (Buckeye)* 22-072-TP-1 22-072-TP-2 22-072-TP-3 22072-TP-4	Arsenic Cadmium Copper Lead Antimony Zinc	708 JX - 17,100 JX 3.9 - 24.9 168 - 1,160 417 - 14,100 76 J - 2,350 J 1,250 - 4,040	2 1 5 0.6 12 4	39, pp. 18, 22, 36-39; 50, pp. 6, 9, 35, 43; 23; 48
Waste Rock** 22-072-WR-1	Arsenic Manganese Lead Mercury Antimony Zinc	628 JX 1,970 1,850 0.342 J 29 J 340	2 3 0.6 0.04 12 4	39, pp. 18, 22, 36-39; 50, pp. 6, 9, 35, 43 23; 48
Waste Rock*** 22-074-WR-1 22-074-WR-2	Arsenic Lead Antimony	5,640 - 22,400 1,000 JX - 3,520 JX 91 J - 291 J	2 0.6 12	39, pp. 18, 22, 36-39; 50, pp. 6, 33, 35, 43 23; 48
Enterprise adit discharge 22-074-SW-4	Arsenic Cadmium Copper Iron Lead Mercury Antimony Zinc	15,500 J 146 1,340 J 131,000 1,340 J 0.081 J 84.2 23,400	2 1 5 20 0.6 0.04 12 4	39, pp. 18, 22, 36-39; 50, pp. 6, 9, 33, 35,43 23; 48
Base of Main Dump BBAD10H	Arsenic Cadmium Copper Lead Zinc	4568 5.43 238.40 4029 117	2 1 5 0.6 4	42, pp. 22, 59; 23; 48
Lower Tailings Wash Area BBAD30H	Arsenic Cadmium Copper Lead Zinc	7698 3.42 149.43 5841 259.75	2 1 5 0.6 4	42, pp. 22, 59; 23; 48
Upper Tailings Wash Area BBAD20H	Arsenic Cadmium Copper Lead Zinc	9173 1.99 95.56 3946 137.51	2 1 5 0.6 4	42, pp. 22, 59; 23; 48

DL Detection Limit
J Estimated Quantity
JX Estimated quantity; outlier for accuracy or precision
ppm Parts per million; equivalent to mg/kg

Notes:
* Sample 22-072-TP-1 is a composite of TP-1A-A, TP-1A-B, and TP-1B-A. Sample 22-072-TP-2 is a composite of TP-1B-B, TP-1B-C, TP-1C-B, and TP-10-B. Sample 22-072-TP-3 is a composite of TP-1C-A and TP-1D-A. Sample 22072-TP-4 is tailings sample TP-E.

** Waste Rock sample 22-072-WR-1 is a composite of samples WR-1A, WR-1B, and WR-1C.

*** Waste Rock sample 22-074-WR-1 is a composite of samples WR-2A and WR-2D. Samples 22-074-WR-2 is composite of WR-2B and WR-2C.

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

Hazardous Constituent Quantity Value (S): NE

2.4.2.1.2 Hazardous Wastestream Quantity

Hazardous Wastestream Quantity Value (W): NE

2.4.2.1.3 Volume

Bullion mine tailings comprise about 4,200 cubic yards; waste rock comprise about 42,150 cubic yards (Figure 2-3) (Ref. 39, p. 30; Ref. 49, pp 7-8).

Buckeye tailings comprise about 20,750 cubic yards; no tailings were noted at the Enterprise. Waste rock at the Buckeye comprise 6,130 cubic yards and at the Enterprise comprise 22,930 cubic yards (Ref. 50, pp. 6,9,33).

Basin Creek Drainage Characterized Mines	Tailings Piles (cubic yards)	Waste Rock (cubic yards)	Total (cubic yards)
Bullion Mine	4,200	42,150	46,350
Buckeye-Enterprise Mine-Mill	20,750	29,060	49,810
Total Volume	**24,950.00**	**71,210.00**	**96,160.00**

The sum of the volume of Tailings Piles and Waste Rock areas, 96,160 cubic yards, is equal to the volume of Source 3. The volume divisor for a waste pile is 2.5 (Ref. 1, Table 2-5).

Calculations:

96,160 ÷ 2.5 = Volume Assigned Value = 38,464

Volume Assigned Value: 38,464

2.4.2.1.4 Area

Tier C was evaluated, therefore Tier D was not evaluated for Source 3.

Area of source (square feet): NE

Area Assigned Value: NE

NE = Not Evaluated

Source Hazardous Waste Quantity Value: 38,464

SOURCE DESCRIPTION

2.2 Source Characterization

Number of the source: 4

Name and description of the source: Jib Tailings Pile

Source 4 consists of the Jib Tailings Pile that is situated south of I-15 along Frontage road. The Jib Tailings Pile is approximately 1,000 feet wide (from east to west), tan/red in color and shows evidence of erosion. A mine head frame, a large tailings pile, and surface impoundments (located east of the Jib Tailings Pile) are the structures that remain at the Jib Complex (Ref. 30, pp. 3, 6; Ref. 47, p. 2; Ref. 7; Ref. 6). The Jib Tailings Pile was characterized by chemical analysis during the 1989 EPA investigation (Ref. 5, pp. 17-21, Ref. 47, pp. 1-2).

The area surrounding Basin, Montana is the site of extensive historical precious metal mining dating from the late 1800s (Ref. 18, p. 12). In the Town of Basin, one of the most productive mines was the Jib Mill/Hope-Katie Mine Complex (Ref. 31, p. 9). Between 1890-1910, the Hope and Katie mines (i.e., Jib Mill Complex) produced $5,000,000 in mineral wealth (Ref. 31, p. 9). Within Sections 17 and 18, Township 6 North, Range 5 West, of Basin, there were 15 patented mining claims associated with the Jib or Hope-Katie Mine (Ref. 28, p. 11). The Jib Mill Complex was also known as Basin Reduction Company, the La France Copper Company, and Jib Consolidated Mining Company (Ref. 34, pp. 3, 4, 5; Ref. 29, p. 14). An historic reference also shows that the Jib Mill Complex was known as the Basin and Bay State Mining Company (Ref. 29, pp. 9, 14). In 1887, a railroad line allowed for the transport of ores to Basin for reduction in the Basin and Bay State Mining Company's Katie Mill concentrator (Ref. 29, p. 9). Fires and floods plagued the operations over the years (Ref. 29, pp. 9-11, 14). However, in 1917, the Jib Mining Company reopened the Katie mill concentrator as the Jib Mill (Ref. 29, pp. 14, 17). In 1923, a 300-ton mill equipped for gravity concentration and flotation was constructed (Ref. 28, p. 11; Ref. 29, p. 17). In 1933, Roy E. Miller, Inc. took over the property, overhauled the mill, and re-worked 48,300 tons of tailings by flotation (Ref. 28, p. 12). In 1953, the property was also open-pit mined by Basin-Jib Gold Mines, Ltd. (Ref. 28, p. 12). The mill burned down in 1975 (Ref. 31, p. 6).

Location of the source:

Source 4 consists of the Jib Tailings Pile that is located in the small, rural Town of Basin, Montana. Basin, Montana is located in Section 17 and 18, Township 6 North, Range 5 West, in Jefferson County, Montana (Ref. 6, p. 1). The Jib Tailings Pile is located immediately southwest of the intersection of the Boulder River and Interstate Highway 15 (Ref. 4, p. 18; Ref. 47, p. 2; Ref. 6).

Containment

Gas/particulate release to air: The air migration pathway was not scored as part of this HRS documentation record.

Release to ground water: The ground water migration pathway was not scored as part of this HRS documentation record.

Release via overland flow and/or flood migration: A containment factor value of 10 is assigned for the surface water migration pathway because no maintained engineered cover or functioning and maintained runon control and runoff management system is known to be in place at the Jib Tailings Pile (Ref. 1, p.

51609, Table 4-2; Ref. 14, p. 7; Ref. 47, p. 2). Runoff from the tailings pile is uncontained and flows north off the tailings pile to Frontage road where it is directed east to Kleinsmith Gulch located on the east side of the pile. Kleinsmith Gulch flows north under I-15 approximately 100 feet where it discharges to the Boulder River through a culvert (Ref. 30, pp. 3-6; Ref. 47, p. 2; Ref. 6; Ref. 5, pp. 13-14).

2.4.1 Hazardous Substances

The hazardous substances detected by chemical analysis of source sample BM-SO-2 collected from the Jib Tailings Pile was used to characterize Source 4. The source sample was collected from Source 4 during an EPA SSI conducted on July 14, 1989 (Ref. 5, p. 15, 20; Ref. 8, pp. 23, 25).

Hazardous Substance	Evidence (Sample Station, concentration in ppm)		Reference
Arsenic	Station BM-SO-2 (MHL946)	72.1	5, p. 34; 8, p. 25; 17, p. 66; 25, p. 1
Copper	Station BM-SO-2 (MHL946)	133	
Lead	Station BM-SO-2 (MHL946)	274 B	
Mercury	Station BM-SO-2 (MHL946)	0.22	
Silver	Station BM-SO-2 (MHL946)	6.5	
Zinc	Station BM-SO-2 (MHL946)	286	

B Detected in laboratory blank. Quantity reported is greater than 5 times the quantity detected in the blank (Ref. 5, p. 35; Ref. 17, p. 75)

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

Hazardous Constituent Quantity Value (S): NE

2.4.2.1.2 Hazardous Wastestream Quantity

Hazardous Wastestream Quantity Value (W): NE

2.4.2.1.3 Volume

Volume Assigned Value: NE

NE = Not Evaluated

2.4.2.1.4 Area

The area of the Jib Tailings Pile was calculated by digitizing the delineated, obvious extent of the tailings pile depicted on a 1979 aerial photograph. The approximate scale of the aerial photograph is 1 inch to 500 feet (Ref. 7, p. 1).

Area of Jib Tailings Pile (square feet): 252,432

The Area Assigned Value is calculated by dividing the area of Source 4 by the waste pile divisor of 13 (Ref. 1, p. 51591, Table 2-5).

Calculations:

252,432 ÷ 13 = Area Assigned Value = 19,417.85

Area Assigned Value: 19,417.85

Source Hazardous Waste Quantity Value: 19,417.85

SITE SUMMARY OF SOURCE DESCRIPTIONS

		CONTAINMENT			
Source No.	**Source Hazardous Waste Quantity Value**	**Ground Water**	**Surface Water**	**Gas**	**Air Particulate**
1	2011.62	NE	10	NE	NE
2	5.28	NE	10	NE	NE
3	38,464	NE	10	NE	NE
4	19,417.85	NE	10	NE	NE
Total	**59,898.75**				

NE = Not Evaluated

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity Factor Value (Ref. 1, Section 2.4.2.2). A Hazardous Waste Quantity Factor Value of 10,000 is assigned to sources whose sum of source hazardous waste quantity values is greater than 10,000 and less than or equal to 1,000,000 (Ref. 1, p. 51591, Table 2-6).

4.0 SURFACE WATER MIGRATION PATHWAY

4.1 OVERLAND/FLOOD MIGRATION COMPONENT

4.1.1.1 Definition of Hazardous Substance Migration Path For Overland/Flood Component

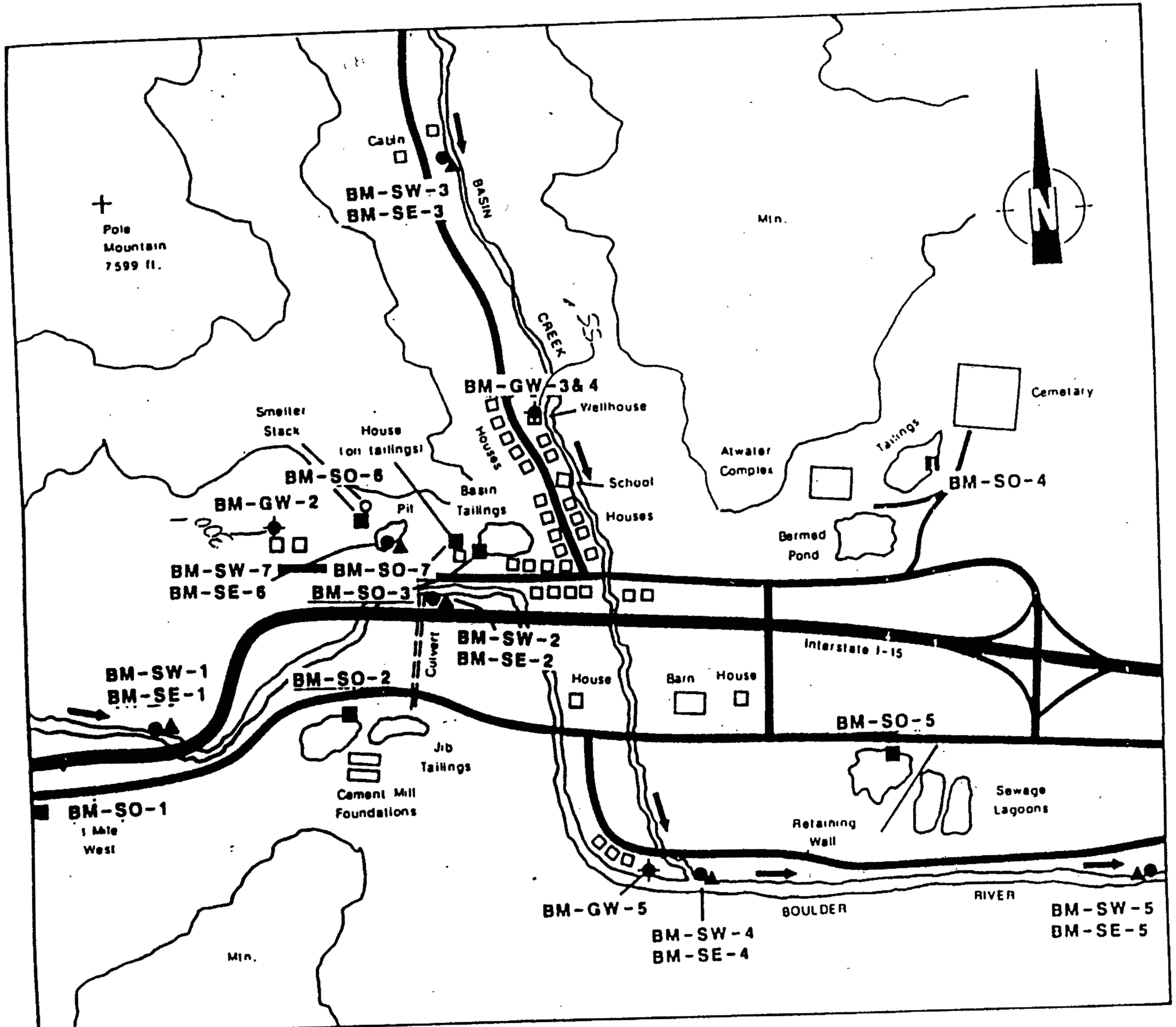
The target distance limit (TDL) for the site begins at the Buckeye-Enterprise Mine/Mill, located along Basin Creek, and ends 21.6 miles downstream in the Boulder River. The entire TDL lies within the Basin Mining Area site that is located on both sides of the Boulder River adjacent to the Town of Basin, as well as along the Basin Creek drainage. Basin Creek flows directly through the Town of Basin joining the Boulder River just south of town. Kleinsmith Gulch flows north into the Boulder River southwest of the Town of Basin and is also located on the east side of the Jib Tailings Pile (Source 4). The entry point of overland flow from the Jib Tailings Pile (Source 4) into the Boulder River has been designated the Probable Point of Entry-1 (PPE-1). The entry point of overland flow downstream of Buckeye mine tailings (Source 3) into Basin Creek has been designated as PPE-2. The general entry point of overland flow from the Basin Tailings Pile (Source 1) and Contaminated Soil (Source 2) into the Basin Creek has been designated as PPE-3. The entry point of overland flow downstream of Bullion Mine (Source 3) into a tributary of Jack Creek has been designated as PPE-4 (Ref. 6).

The Boulder River flows east through the Basin Mining Area site before turning south at the Town of Boulder, Montana and flowing southeast to meet the Jefferson River near Cardwell, Montana (Ref. 36). Average annual discharge of the Boulder River at the Town of Boulder (9.2 miles downstream of Basin, Montana) is 117 cubic feet per second (cfs). There are no gaging stations on Basin Creek (Ref. 20, p. 3).

During the 1989 EPA investigation, "a seep" (aka Kleinsmith Gulch) that channeled directly into the Boulder River was noted at the base of the Jib Tailings Pile (Ref 8, p. 16; Ref. 30, pp. 3, 6; Ref. 6). Drainage patterns from the Jib Tailings Pile indicate that surface water flows north off the tailings pile and then east the whole length of the pile, where it is directed into Kleinsmith Gulch, which flows about 100 feet before discharging into the Boulder River (Ref. 7, pp. 1-2; Ref. 30, pp. 3, 6; Ref. 47, p. 2).

The eastern edge of the area of Contaminated Soil (Source 2), at Basin School, lies approximately 200 feet west of Basin Creek. The general drainage patterns from the Basin Tailings Pile and the area of Contaminated Soil generally flow southeast. It is unclear where overland flow would reach Basin Creek, but it is likely to be directed to Basin Creek on the north side of Interstate 15 (Ref. 6; Ref. 47, p. 1; Ref. 30, p. 6).

The mines in the Basin Mining Area site and surrounding Boulder River tributaries have negatively affected the water quality in the Boulder River (Ref. 64, p. 5). Annual loads of metals from Basin Creek, and other sites in the Boulder River drainage were evaluated by the USGS. Their water quality data collected from 1989 to 1996 (12 sample sets) indicate that Basin Creek, along with Cataract Creek and High Ore Creek contributed 33 percent of the annual streamflow and 41-89 percent of the cadmium, copper, lead, and zinc loads to the Boulder River (Ref. 64, p. 5).



NOT TO SCALE

05 028

LEGEND

- ■ Soil sample
- ● Surface water sample
- ▲ Sediment sample
- ✦ Domestic well

Figure 4-1

FIELD INVESTIGATIONS OF UNCONTROLLED HAZARDOUS WASTE SITES TASK REPORT TO THE E.P.A.	
TITLE BASIN MINING SITE Basin, Montana SAMPLE LOCATION MAP	
T.D.D. F08-8904-01	
ecology & environment, inc. DENVER, COLORADO	
Date: 08/89 Drawn by: RSM Scale:	

4.1.2.1 Likelihood of Release

4.1.2.1.1 Observed Release

Direct Observation

An observed release by direct observation at the Bullion Mine has been identified for an unnamed tributary to Jack Creek that flows through tailings impoundments (Ref. 42, pp. 42), and for Jack Creek where waste materials and tailings were observed to be actively eroded and washed into the streams (Ref. 42, p. 45; Ref. 49, p. 11). An observed release by direct observation can also be documented for the Buckeye-Enterprise Mine-Mill because its mining wastes have been found to be in contact with surface water in Jack Creek (Ref 1, Table 4-2, p. 51609; Ref. 50, pp. 7, 9, 11). Also the waste rock and tailings at the Enterprise adit were found to be in contact with Basin Creek (Ref. 50, pp. 11-12, 36; Ref. 39, pp. 38-39; Ref. 42, pp, 54-55).

Chemical Analysis

The following tables provide analytical data to document the observed release by chemical analysis.

Boulder River

Analysis of a sediment sample collected from locations BM-SE-2 and BE-SE-5 collected during the 1989 EPA investigation indicated the presence of hazardous substances at concentrations greater than three times the respective background levels (BE-SE-1) collected in the Boulder River (Ref. 5, p. 33; Ref. 8, pp. 22, 25; Ref. 17, pp. 60, 61, 63). Sediment sample BM-SE-1 was collected in the Boulder River upstream of the intersection of the Boulder River and Interstate I-15. This background location is upstream of all PPEs and overland flow draining from potentially contaminated areas associated with the site (Figure 4-1) (Ref. 5, pp. 28, 33; Ref. 6; Ref. 8, pp. 12-13).

Background Concentrations-Boulder River Sediment

Background Sample ID	Sample Location	Depth/ Matrix	Date	Reference
BM-SE-1, MHL934	Upstream of intersection of I-15 and Boulder River	Sediment	7/16/89	8, pp. 22, 25

Background Sample ID	Hazardous Substance	Concentration (ppm)	SQL	Reference
BM-SE-1, MHL934	Arsenic	6.1	2.84	8, p. 25; 17, p. 60; 24
	Cadmium	0.85U	1.42	
	Copper	14.9	7.10	
	Lead	8.6 B	0.85	
	Manganese	304	4.26	
	Mercury	0.14U	0.14	
	Silver	1.7 U	2.84	
	Zinc	45.8	5.68	

B Detected in laboratory blank. Quantity reported is greater than 5 times the quantity detected in the blank (Ref. 5, pp. 33, 40-41; 17, p. 75).
ppm Part per million
SQL Sample Quantitation Limit
U The material was analyzed for, but was not detected.

Release Concentrations - Boulder River Sediment

Release Sample ID	Sample Location	Depth/ Matrix	Date	Reference
BM-SE-2, MHL935	PPE-1, intersection of Kleinsmith Gulch and the Boulder River	Sediment	7/16/89	8, pp. 22, 25
BM-SE-5. MHL938	East of Town of Basin	Sediment	7/16/89	8, pp. 22, 25

Release Sample ID	Hazardous Substance	Concentration (ppm)	SQL (ppm)	Reference
BM-SE-2, MHL935	Arsenic	36.4	27.4	8, p. 25; 17, p. 61; 24
	Copper	114	6.9	
	Lead	146 B	16.5	
	Silver	5.6	2.7	
	Zinc	210	5.5	
BM-SE-5, MHL938	Arsenic	63.0	11.43	8, p.25; 17, p. 63; 24
	Cadmium	2.6	0.86	
	Copper	104	1.14	
	Lead	66.9 B	5.71	
	Silver	5.9	1.71	
	Zinc	264	4.57	

B Detected in laboratory blank. Quantity reported is greater than 5 times the quantity detected in the blank (Ref. 5, pp. 33, 40-41; Ref. 17, p. 75)
ppm Parts per million
SQL Sample Quantitation Limit

Background Concentrations-Boulder River Surface Water

Collocated surface water samples were collected at sediment sample stations BM-SE-1 and BM-SE-2. Chemical analysis of the surface water sample BM-SW-2 indicated the presence of hazardous substances at least three time the background hazardous substance concentrations detected in surface water sample BM-SW-1 (Ref. 5, p. 31; Ref. 8, pp. 20, 26; Ref. 17, pp. 4-5).

Background Sample ID	Sample Location	Depth	Date	Reference
BM-SW-1, MHL924	Upstream of intersection of I-15 and Boulder River	Surface Water	7/16/89	5, p. 28; 8, pp. 20, 26

Background Sample ID	Hazardous Substance	Concentration (ppb)	SQL (ppb)	Reference
BM-SW-1, MHL924	Arsenic	[5.4]	10	5, p. 31; 8, p. 26; 17, p. 4; 24
	Cadmium	ND	5	
	Copper	ND	25	
	Lead	[1.0]	3	
	Manganese	15.4 UJ	15	
	Mercury	ND	0.2	
	Silver	ND	10	
	Zinc	20.8	20	

ND Not Detected
UJ Reporting limit is estimated; the analyte was not detected.
[ ] The associated numerical value is an estimated quantity because the amount detected is below the contract required detection limit (CRDL). Presence of the material is reliable.
SQL Sample Quantitation Limit
ppb Parts per billion

<u>Release Concentrations-Boulder River Surface Water</u>

Release Sample ID	Sample Location	Depth	Date	Reference
BM-SW-2, MHL929	PPE-1, intersection of Kleinsmith Gulch and the Boulder River	Surface Water	7/16/89	8, pp. 20, 26 5, p. 28

Release Sample ID	Hazardous Substance	Concentration (ppb)	SQL (ppb)	Reference
BM-SW-2, MHL929	Lead	5	3	5, p. 31;8, p. 26; 17, p. 5;24
	Zinc	65	20	

ppb Parts per billion
SQL Sample Quantitation Limit

<u>Basin Creek</u>

Surface water and sediment samples 22-074-SW-1 and 22-074-SE-1 provided background data for Basin Creek samples collected downstream of the Source 3 mines and extending to the confluence with the Boulder River (Ref. 50, p. 37; Ref. 6). The background sample was collected upstream of the Buckeye-Enterprise mine-mill on Basin Creek, 100 feet above the confluence with the unnamed tributary (Ref. 50, pp. 5, 37; Ref. 6).

Background Concentrations-Basin Creek Sediment

Background Sample ID	Sample Location	Depth/Matrix	Date	Reference
22-074-SE-1	Upstream of Buckeye-Enterprise mine-mill on Basin Creek	Sediment	7/6/93	50, p. 37, 39

Background Sample ID	Hazardous Substance	Concentration (mg/kg)	DL (ppm)	Reference
22-074-SE-1	Arsenic Cadmium Copper Lead Antimony	15 0.6 U 14.19 (12.9 J) 34 JX 7 UJ	2 1 5 0.6 12	39, p. 22, 36, 38; 50, pp. 37, 43; 23; 48; 35, pp. 4, 13

DL Detection Limit
J Estimated quantity
JX Estimated quantity; outlier for accuracy or precision
ppm Parts per million; equivalent to mg/kg
U Not detected
( ) Analytical detection times the bias factor (Ref. 35)
UJ The reported quantitation limit is estimated because Quality Control criteria were not met. The compound was not detected.

Release Concentration-Basin Creek Sediment

Release Sample ID	Sample Location	Depth/Matrix	Date	Reference
22-072-SE-3	Downstream of Buckeye tailings (PPE-2 in Basin Creek)	Sediment	7/6/93	50, pp. 6, 12; 39, p. 37
BM-SE-3, MHL935	0.75 miles upstream of the Town of Basin	Sediment	7/16/89	5, p.14; 8, pp. 22, 25
BM-SE-4, MHL937	Basin Creek near the confluence with the Boulder River	Sediment	7/16/89	5, p.14; 8, pp. 22, 25

Release Sample ID	Hazardous Substance	Concentration (mg/kg)	DL or SQL (ppm)	Reference
22-072-SE-3	Arsenic Copper Lead Antimony	997 JX 44.3 589 41.11 (74 J)	2 5 0.6 12	39, pp. 22, 37; 50, p. 12; 23; 48; 35, pp. 4, 13
BM-SE-3, MHL935	Arsenic Cadmium Copper Lead	121 5.9 95.7 148 B	13.36 1.0 1.34 6.68	5, p. 33; 24
BM-SE-4, MHL937	Arsenic Cadmium Copper Lead	131 5.7 78.8 125 B	11.98 0.90 1.20 5.91	5, p. 33; 24

B Material was detected in the laboratory blanks. Quantity reported is >5x the amount found in the blank. A false positive may exist.
DL Detection Limit
J Estimated quantity
JX Estimated quantity; outlier for accuracy or precision
ppm Parts per million; the equivalent of mg/kg
SQL Sample Quantitation Limit
( ) Analytical detection divided by the bias factor (Ref. 35)

Background Concentrations-Basin Creek Surface Water

Background Sample ID	Sample Location	Depth/Matrix	Date	Reference
22-074-SW-1	Upstream of Buckeye-Enterprise mine-mill on Basin Creek	Surface Water	7/6/93	50, pp. 5, 11, 37; 39, pp. 22, 39

Background Sample ID	Hazardous Substance	Concentration (µg/L)	DL (ppb)	Reference
22-074-SW-1	Arsenic Cadmium Copper Lead Manganese Zinc	4.45 (3.71 J) 2.57 U 2.92 (2.43 J) 6.5 (5.42 J) 13.3 12.9	10 5 25 3 15 20	39, p. 22, 39; 50, p. 37, 43; 48; 35, pp. 4, 13

DL Detection Limit
J Estimated quantity
U Not detected
ppb Parts per billion; the equivalent of μg/L
( ) Analytical detection times the bias factor (Ref. 35)

Release Concentration-Basin Creek Surface Water

Release Sample ID	Sample Location	Depth/Matrix	Date	Reference
22-072-SW-3	Downstream of Buckeye tailings (PPE-2 in Basin Creek)	Surface Water	7/6/93	50, pp. 6, 12, 39, p. 37
BM-SW-3, MHL-930	0.75 miles upstream of the Town of Basin	Surface Water	7/16/89	5, p.28; 8, pp. 20, 26
BM-SW-4, MHL-931	Basin Creek near the confluence with the Boulder River	Surface Water	7/16/89	5, p.28; 8, pp. 20, 26

Release Sample ID	Hazardous Substance	Concentration (µg/L)	DL or CRDL (ppb)	Reference
22-072-SW-3	Arsenic Manganese Zinc	18.1 161 JX 137.5(165 J)	10 15 20	39, pp. 22, 37; 50, pp. 6, 12; 48; 35, pp. 4, 13
BM-SW-3, MHL930	Zinc	50.3	20	5, p. 31; 48
BM-SW-4, MHL931	Zinc	44.3	20	5, p. 31; 48

CRDL Contract Required Detection Limit
DL Detection Limit
J Estimated quantity
JX Estimated quantity; outlier for accuracy or precision
ppb Parts per billion; the equivalent of μg/L
SQL Sample Quantitation Limit
( ) Analytical detection divided by the bias factor (Ref. 35)

Attribution:

Hazardous substances detected in samples collected from the Boulder River at locations downstream from its confluence with Basin Creek (e.g., BM-SE-5) can be attributed to the sources at the Basin Mining Area site (i.e., Sources 1, 2, 3, and 4).

Basin Creek flows adjacent to the southern portion of the Buckeye mine tailings (Source 3) near the headwaters of Basin Creek. Overland flow draining the Buckeye tailings (Source 3) enters Basin Creek at PPE-2, which is located approximately 13.6 miles upstream of the confluence of Basin Creek and Boulder River (Ref. 50, pp. 5, 6, 12; Ref. 6). PPE-2 is located downstream of the Buckeye tailings (Ref. 6; Ref. 50 p. 7). The hazardous substances (arsenic, copper, lead, antimony, manganese, zinc) detected at elevated concentrations at PPE-2 in sediment sample (22-072-SE-3) and surface water sample (22-072-SW-3) were also detected in samples collected from Source 3 (Ref. 50, pp. 6, 8, 9, 12, 33, 35, 43: Ref. 39, pp. 36-39).

Hazardous substances were also detected in Basin Creek at locations at approximately 10 miles downstream of the Source 3 mines. Surface water and sediment samples BM-SW-3/BM-SE-3 and BM-SW-4/BM-SE-4 were collected along Basin Creek at locations 0.75 miles upstream of Basin, Montana, and just upstream of the confluence of Basin Creek with the Boulder River, respectively (Figure 4-1) (Ref. 5, p. 14). Samples BM-SW-4/BM-SE-4 are also located approximately 13.6 miles downstream of PPE-2, 0.3 miles downstream of PPE-3, and 10 miles downstream of PPE-4 on Basin Creek (Ref. 6). The concentrations of arsenic, cadmium, copper, and lead in BM-SW-4/BM-SE-4 were greater than or equal to three times the concentrations in Basin Creek background sediment sample 22-074-SE-1 collected upstream of the Buckeye mine tailings (Source 3) (Ref. 5, p. 33; Ref. 39, p. 36, 38; Ref. 50, pp. 37, 43). The surface water zinc concentrations were also greater than or equal to three times the concentrations in Basin Creek background surface water sample 22-074-SW-1 (Ref. 5, p. 31; Ref. 39 p. 36, 38; Ref. 50 pp. 37). Arsenic, cadmium, copper, lead, and zinc were detected in the mine tailings piles comprising Source 3 (see Section 2.2 of this HRS documentation record).

Hazardous substances (arsenic, copper, lead, silver, and zinc) were detected at elevated concentrations in samples BM-SW-2 and BM-SE-2 collected at PPE-1. These hazardous substances were also were detected in samples collected from the Jib Tailings Pile (Source 4); overland flow from Jib Tailings Pile discharges into the Boulder River at PPE-1 at sample locations BM-SW/SE-2 (Ref. 5, pp. 22, 34; Ref. 8, pp. 23, 25; Ref. 17, p. 61).

Overland flow that drains from the Basin Tailings Pile (Source 1), the area of Contaminated Soil (Source 2), the mines along Basin Creek (Source 3), and the Jib Tailings Pile (Source 4) ultimately reach the Boulder River sample location BM-SE-5 (Figure 4-1) (Ref. 5, p.14; Ref. 6). Hazardous substances (arsenic, cadmium, copper, lead, silver, and zinc), detected at elevated concentrations in downstream sediment sample BM-SE-5 (Ref. 5, p. 18; Ref. 8, p. 25; Ref. 17, p. 63), were also detected in Sources 1, 2, 3 and 4 (see Section 2.2 of this HRS documentation record). The valley in which the Town of Basin lies is only 0.1 to 0.5 miles wide to the base of the mountains on the north and south sides of the valley (Ref. 6). Precipitation drainage/overland flow off the tailings piles, mine fires, flooding, transportation and/or distribution of waste rock, etc., may have contributed to contaminated surface water and sediment in Basin Creek and the Boulder River (Ref. 30; Ref. 47).

About 400 mining claims were staked in the mountains surrounding Basin and were developed to some degree (Ref. 31, p. 9). The Basin Creek Drainage consisted of 39 mines; 14 of which were identified as having a potential to contribute to environmental degradation (Ref. 42 pp. 36; Ref. 6). Other potential sources in the Basin Creek drainage or in the Town of Basin along the Boulder River exist but have not been fully characterized with respect to the surface water pathway (Ref. 6; Ref. 7). Although other potential sources have contributed to contamination in the Boulder River, EPA has established that at least a portion of the observed release downstream of the confluence of Basin Creek and the Boulder River is attributable to the sources evaluated at this site. Sediment sample BM-SE-5 is located in the Boulder River 0.4 miles downstream of the Basin Creek/Boulder River confluence and, therefore, has been influenced by overland flow from the Basin Mining Area site Sources 1, 2, 3, and 4 (Ref. 6).

Observed Release Factor Value: 550

4.1.3.2 Waste Characteristics

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

The Toxicity/Persistence/Bioaccumulation Values are based on the hazardous substances that were detected in Sources 1, 2, 3, and 4 in samples collected during the 1989 and 1991 EPA sampling events (Ref. 3; Ref. 5) and the MDSL/AMRL 1994/1995 sampling events (Ref. 39; Ref. 40; Ref. 41).

Hazardous Substance	Source Number	Toxicity Factor Value	Persistence Factor Value**	Bioaccumulation Value*** (Food Chain)	Toxicity/ Persistence/ Bioaccumulation Factor Value (Ref. 1, Table 4-16)	Reference
Antimony	3	10,000	1.0	0.5	5,000	1, Table 4-16; 2, B1-B18; 8, p. 25; 17, pp. 68-69; 30, pp. 1-7
Arsenic	1,2,3,4	10,000	1.0	5	5×10^4	
Cadmium	2,3	10,000	1.0	5,000	5×10^7	
Copper	1,2,3,4	----	1.0	50,000	0	
Iron	3	1	1.0	0.5	0.5	
Lead	1,2,3,4	10,000	1.0	50	5×10^5	
Manganese	3	10,000	1.0	0.5	5,000	
Mercury	2,3,4	10,000	0.4	50,000	2×10^8	
Silver	1,4	100	1.0	50	5,000	
Zinc	1,3,4	10	1.0	500	5,000	

** Persistence values assigned are based on the predominant surface water body category "River"

*** Bioaccumulation values assigned are based on the predominant surface water category of fresh water.

The hazardous substance with the highest Toxicity/Persistence/Bioaccumulation Factor Value is mercury with a value of 2.0×10^8 (Ref. 1, Section 4.1.3.2.1.4, Table 4-16; Ref. 2, pp. B-2, B-13).

Toxicity / Persistence / Bioaccumulation Factor Value: 2×10^8

4.1.3.2.2 Hazardous Waste Quantity

Source Number	Source Hazardous Waste Quantity Value	Is source hazardous constituent quantity data complete? (Yes/No)
1	2011.62	No
2	5.42	No
3	38,464	No
4	19,417.85	No
Total	59,898.89	

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity Factor Value (Ref. 1, Section 2.4.2.2). A Hazardous Waste Quantity Factor Value of 10,000 is assigned to a site whose sum of source hazardous waste quantity values is greater than 10,000 and less than or equal to 1,000,000 (Ref. 1, Table 2-6).

Sum of values: 59,898.89
Hazardous Waste Quantity Factor Value: 10,000

Hazardous Waste Quantity Factor Value: 10,000

4.1.3.2.3 Waste Characteristics Factor Category Value

The Toxicity/Persistence Factor Value for mercury is 4,000 (See Sec. 4.1.3.2.1).

Toxicity / Persistence Factor Value = 4,000
Hazardous Waste Quantity Factor Value = 10,000

Toxicity/persistence factor value
x hazardous waste quantity factor value: 4×10^7

The Bioaccumulation Potential Factor Value of 50,000 for mercury is used to calculate the Waste Characteristic Factor Value.

Bioaccumulation Potential Factor Value = 50,000

(Toxicity/persistence x hazardous waste quantity)
x bioaccumulation potential factor value: 2×10^{12}

A Waste Characteristics Product Value of 1×10^{12} is assigned (due to maximum value) and receives a Waste Characteristics Factor Category Value of 1,000 for the Human Food Chain Threat (Ref. 1, Table 2-7).

Hazardous Waste Quantity Assigned Value: 10,000
Waste Characteristics Factor Category Value: 1,000

4.1.3.3 Human Food Chain Threat-Targets

The Boulder River has been classified by the State of Montana as a class B-1 surface water body. This classification designates the section of the Boulder River included in the target distance limit for use as drinking water, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply (Ref. 19, pp. 6, 11; Ref. 36). The Boulder River at Basin has the following listed impaired uses; aquatic life support, cold water fishery - trout, drinking water supply, recreation, and swimmable (Ref. 60, pp. 2-3). The probable causes and sources of the impairments include flow alteration, metals, nutrients, other habitat alterations, siltation, and thermal modifications resulting from agriculture, irrigated crop production, mill tailings, resource extraction, and subsurface mining (Ref. 60, pp. 2-3).

The Basin Creek drainage has been classified by the State of Montana as an A-1 surface water body. This classification designates the section of Basin Creek included in the target distance limit for use as drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; agricultural and industrial water supply (Ref. 19, pp. 6, 9-10; Ref. 36). Basin Creek has the following listed impaired uses; aquatic life support and cold water fishery - trout (Ref. 60, pp. 2-3). The probable causes and sources of the impairments include metals and siltation resulting from placer mining, resource extraction, and subsurface mining (Ref. 60, pp. 2-3).

Boulder River and Basin Creek are considered cold water trout fisheries, with standard fishing seasons open from the third Saturday in May through November 30 (Ref. 56, p. 5; Ref. 57, p. 3). The Montana Fish and Wildlife Service has observed evidence of fishing in Basin Creek and the Boulder River including a fairly high incidence of fish hook scarring on the fish captured from these water bodies. The recreational catch and release fishing rate is low, however, and therefore the probability is high that the fish are consumed from the Boulder River and Basin Creek (Ref. 65). During the June 1999 EPA site visit, a recreational fisherman was interviewed. He was camping 0.1 miles north of the power line that crosses Basin Creek road approximately 3.4 miles northwest of the confluence with the Boulder River (Ref. 6; Ref. 30, p. 2). He had caught numerous cutthroat trout and ate one brook trout for breakfast (Ref. 30, p. 2). A local Town of Basin restaurant owner also noted that he has observed many people fishing Basin Creek and the Boulder River. Brook trout are usually caught at the confluences of Basin Creek and the Boulder River (Ref. 30, p. 2, 3).

Actual Human Food Chain Contamination

Surface Water and Sediment Samples-Boulder River

Sediment and surface water samples, BM-SE-2/MHL935 and BM-SW-2/MHL929 were collected from the Boulder River at PPE-1 (Ref. 8, p. 12, 13). Sediment sample location BM-SE-5/MHL938 was collected approximately 1 mile downstream of PPE-1 on the Boulder River (Figure 4-1). This location is approximately 0.4 miles downstream of the confluence of Boulder River with Basin Creek. Therefore, BM-SE-5 is located 14 miles downstream of PPE-2 (located on Basin Creek), 0.7 miles downstream of PPE-3 (located on Basin Creek), and 10.4 miles downstream of PPE-4 (located on a tributary to Jack Creek) (Ref. 6).

Sample ID	Distance from Probable Point of Entry	Hazardous Substance	Concentration (ppm)	Bioaccumulation Potential Factor* Value
BM-SE-2, MHL935	0.0 feet (from PPE-1)	Zinc	210	500
BM-SW-2, MHL929	0.0 feet (from PPE-2)	Zinc	0.065	500
BM-SE-5, MHL938	(see paragraph above)	Zinc	264	500

* The Bioaccumulation Factor Value was obtained from the Human Food Chain, Fresh Water Category (Ref. 2, p. B-20).

Surface Water and Sediment Samples-Basin Creek

Actual contamination of the human food chain in Basin Creek has been established with sediment samples collected from Basin Creek at locations BM-SE-3 and BM-SE-4 (Ref. 50, pp. 5, 11, 37; Ref. 8, p. 22, 25). Sediment sample location BM-SE-3 was collected in Basin Creek approximately 0.75 miles upstream of the confluence of Basin Creek and the Boulder River. This sample is located approximately 12.85 miles downstream of PPE-2 and 9.25 miles downstream of PPE-4. Sediment sample BM-SE-4 was collected on Basin Creek just prior to the confluence with the Boulder River. This sample is located approximately 13.6 miles downstream of PPE-2, 0.3 miles downstream of PPE-3, and 10 miles downstream of PPE-4 (Figure 4-1) (Ref. 6).

Sample ID	Distance from Probable Point of Entry	Hazardous Substance	Concentration (ppm)	Bioaccumulation Potential Factor* Value
BM-SE-3, MHL935	12.85 miles (see paragraph above)	Cadmium	5.9	5,000
BM-SE-4, MHL937	13.6 miles (see paragraph above)	Cadmium	5.7	5,000

* The Bioaccumulation Factor Value was obtained from the Human Food Chain, Fresh Water Category (Ref. 2, p. B-4).

Closed Fisheries

There is no documentation of closed fisheries within the target distance limit.

Finfish Samples

In 1998, the USGS collected samples from rainbow trout (liver and gills) for metals analyses from stations on the Boulder River and Basin Creek (Ref. 56, pp. 4, 8, 13-14). The metals data for the fish gills and livers were not validated and specific laboratory numbers from the testing were not included in the draft report. Specific information required to interpret this data was not provided in the draft report, such as the number of fish sampled, size class of fish, and type of sample tested (individual or composite) (Ref. 56). The station on Lower Basin Creek (LBC) was located near the Town of Basin (Figure 4-2) (Ref. 56, p.8).

<u>Level I Concentrations</u>

There is no documentation of Level I concentrations (Ref. 1, p. 51620).

The following table summarizes the results of the metals testing from the gills and livers of rainbow trout collected from Lower Basin Creek (sample LBC) near the Town of Basin (Figure 4-2) (Ref. 56, pp. 8, 13, 14).

Lower Basin Creek
Finfish Sample LBC

Hazardous Substance	Concentration (ppm) (Gills/Livers)	Benchmark Concentration	Benchmark	Reference
Arsenic	>3.0/>7.0	0.0021mg/kg	Cancer Risk	2, pp. B-44, B-46, B-62; 56, pp. 8, 13, 14
Lead	>1.0/>0.0	NA	NA	
Copper	>7.0/>4.0	NA	NA	
Cadmium	>3.0/>2.0	0.68 mg/kg	Reference Dose	
Zinc	>8.0/>1.0	410 mg/kg	Reference Dose	

The concentrations of copper were elevated in gills of fish from Lower Basin Creek (LBC). The concentrations of cadmium and lead in gills were elevated in LBC and the Boulder River at Galena Gulch (BRGG). The station at BRGG had the greatest concentrations of lead and zinc. Arsenic, copper, cadmium, lead, and zinc were all elevated in the livers of fish from LBC and BRGG. For all metals except lead in livers, the concentrations in LCC were the greatest (Ref. 56, p. 4, 8, 13-14).

Level II Concentrations

The Basin Creek fishery is subject to Level II concentrations (Ref. 1, p. 52620).

Level I Fisheries

There are no Level I fisheries (Ref. 1, p. 51620).

Most Distant Level II Sample-Boulder River

The most distant Level II observed release sediment sample BM-SE-5 collected from the Boulder River approximately 1 mile downstream of PPE-1, 14 miles downstream of PPE-2, 0.7 miles downstream of PPE-3, and 10.4 miles downstream of PPE-4 (Ref. 6; Ref. 5, p. 33; Ref. 8, p. 25; Ref. 17, p. 63).

Sample ID: BM-SE-5/MHL938
Sample medium: .... Sediment
Distance from Probable Point of Entry (PPE-1) .... 1 mile

Most Distant Level II Sample-Basin Creek

The most distant Level II observed release sediment sample is sample BM-SE-4 collected at the confluence of Basin Creek and the Boulder River located approximately 13.6 miles downstream of PPE-2, 0.3 miles downstream of PPE-3, and 10 miles downstream of PPE-4 (Ref. 6).

Sample ID: BM-SE-4/MHL937
Sample medium: .... Sediment
Distance from Probable Point of Entry (PPE-2) .... 13.6 miles

Level II Fisheries

Identity of Fishery	**Extent of Level II Fishery Relative to Probable Point of Entry**
Basin Creek	13.6 miles (from PPE-2)
Boulder River	1 mile (from PPE-1)

4.1.3.3.1 Food Chain Individual

Actual contamination of the Boulder River fishery was documented at Level II concentrations in surface water and sediment samples BM-SW/SE-2 and BM-SE-5 (Ref. 6; Ref. 5, pp. 31, 33; Ref. 8, pp. 25, 26; Ref. 17, pp. 60-61, 63; Ref. 56, pp. 13, 14). This fishery is subject to Level II concentrations (Ref. 1, Sec. 4.1.3.3.1).

Actual contamination of the Basin Creek fishery was documented at Level II concentrations in sediment samples BM-SE-3 and BM-SE-4 (Ref. 6). Both fisheries are subject to Level II concentrations; therefore, a value of 45 is assigned to the Human Food Chain Individual Factor Value (Ref. 1, Sec. 4.1.3.3.1).

Food Chain Individual Factor Value: 45

4.1.3.3.2 **Population**

4.1.3.3.2.1 **Level I Concentrations**

Not applicable.

4.1.3.3.2.2 **Level II Concentrations**

The extent of the Level II contamination of the Basin Creek fishery is 13.6 miles (distance from PPE-2 in Basin Creek to the Boulder River) (Ref. 59; Ref. 6). The extent of the Level II contamination of the Boulder River fishery is 1 mile (distance from PPE-1 in the Boulder River to sediment sample BM-SE-5).

The annual production for these segments of Basin Creek and Boulder River have not been documented, but these segments are known fisheries (Ref. 9, p. 4; Ref. 30, pp. 2,3; Ref. 56, p. 5; Ref. 57, p. 3; Ref. 65, p. 1). Therefore, a minimum value of greater than 0 to 100 pounds is assigned as the human food chain production (Ref. 1, Section 4.1.3.3.2.2). For an annual production of greater than 0 to 100 pounds per year, a Human Food Chain Population Value of 0.03 is assigned for each fishery (Ref. 1, Table 4-18).

Identity of Fishery	Annual Production (pounds)	Reference	Human Food Chain Population Value (P_1) (Ref. 1, Table 4-18)
Basin Creek	> 0	1, p. 51621	0.03
Boulder River	> 0	1, p. 51621	0.03

Sum of Human Food Chain Population Values: 0.06

Level I Concentrations Factor Value: 0
Level II Concentrations Factor Value: 0.06

4.1.3.3.2.3 Potential Human Food Chain Contamination

The Boulder River fishery from 1 mile downstream of PPE-1 to 14 miles downstream of PPE-1 (the TDL) is subject to potential human food chain contamination (see Section 4.1.3.3). Values for the amount of human food chain organisms harvested annually from the Boulder River have not been adequately documented but this segment is a known fishery. Because specific production data are not available, production is estimated at greater than 0 to 100 pounds per year.

Identity of Fishery	Production (pounds)	Type of Surface Water Body	Average Annual Flow	Ref.	Population Value (P_i)	Dilution Weight (D_i)	P_i x D_i
Boulder River	> 0	river	117 cfs	9, p. 4; 20, pp. 2-3; 1,Table 4-13	0.03	0.01	0.0003

Estimated pounds of fish harvested from the Boulder River: > 0

Potential Human Food Chain Contamination Factor Value: 3 x 10^{-5}

4.1.3.3.2.4 Calculation of Population Factor Value

The population factor value is calculated by summing the value of Level I concentration (0), Level II concentration (0.06) and potential human food chain contamination factors for the watershed (0.00003). the resulting value is assigned the population factor value for the watershed (Ref. 1, Section 4.1.3.3.2.4).

Calculations:

$$0 + 0.06 + 0.00003 = 0.06003$$

4.1.3.3.3 Calculation of a Human Food Chain Threat - Targets Factor Category Value

The Human Food Chain Threat-Target Factor Category Value is calculated by summing the Food Chain Individual (45) and Population Factor Value of the watershed (0.06003). The resulting value, 45.06003, is assigned as the Human Food Chain Threat-Target Score (Ref. 1, Sec. 4.1.3.3.2).

4.1.3.4 Calculation of a Human Food Chain Threat Score for a Watershed

The Human Food Chain Threat is calculated by multiplying the Human Food Chain Threat Factor Category Value for likelihood of release (550), Waste Characteristics (1,000) and Targets for a Watershed (45.06003). The product is rounded to the nearest integer and divided by 82,500. The resulting value, subject to a maximum of 100, is assigned as the Human Food Chain Threat Score for the watershed (Ref. 1, Sec. 4.1.3.4).

Calculations:

$$(550 \times 1{,}000 \times 45.06003) \div 82{,}500 = 300.4$$

The maximum value of 100 applies.

Human Food Chain Threat Score: 100

4.1.4.2 ENVIRONMENTAL THREAT WASTE CHARACTERISTICS

The Boulder River is designated by the State of Montana as Class B-1 surface water body of the Missouri River drainage (Ref. 19, p. 6; Ref. 36). A Montana State B-1 classification designates a surface water body as suitable for the growth and propagation of salmonid fishes and associated aquatic life (Ref. 19, p. 11; Ref. 36). The Boulder River surface water body is a sensitive environment designated for the protection and maintenance of aquatic life (Ref. 1, Table 4-23).

Basin Creek is designated by the State of Montana as Class A-1 surface water body of the Missouri River drainage (Ref. 19, p. 6; Ref. 36). A Montana State A-1 classification designates a surface water body as suitable for the growth and propagation of salmonid fishes and associated aquatic life (Ref. 19, p.9-10; Ref. 36).

4.1.4.2.1 <u>Ecosystem Toxicity/Persistence/Bioaccumulation</u>

The Ecosystem Toxicity/Persistence/Bioaccumulation Values are based on the contaminants detected in Sources 1, 2, 3, and 4.

Hazardous Substance	Source No.	Ecotoxicity** Factor Value	Persistence Factor Value*** (River)	Bioaccumulation Factor Value (Env./Fresh)	Ecotoxicity/ Persistence/ Bioaccumulation Factor Value	Ref.
Antimony	3	100	1.0	5	500	1, Tables 4-20, 4-21, pp. 51622, 51623; 2, pp. B-1–B-21
Arsenic	1,2,3,4	10	1.0	500	5,000	
Cadmium	2,3	1,000	1.0	5,000	5×10^6	
Copper	1,2,3,4	100	1.0	50,000	5×10^6	
Iron	3	10	1.0	0.5	5	
Lead	1,2,4	1,000	1.0	5,000	5×10^6	
Manganese	3	----	1.0	50,000	0	
Mercury	2,3,4	10,000	0.4	50,000	2×10^8	
Silver	1,4	10,000	1.0	50	5×10^5	
Zinc	1,3,4	10	1.0	500	5,000	

** Ecotoxicity values assigned are based on the predominant surface water category of fresh water.
*** Persistence values assigned are based on the predominant surface water body category 'River'.

Mercury has the highest Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value for this Watershed, 2×10^8 (Ref. 1, Table 4-21; Ref. 2, p. B13; Ref. 1, Section 4.1.4.2.1.4).

Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value: 2×10^8

4.1.4.2.2. Hazardous Waste Quantity

The factor value derived for the drinking water threat hazardous waste quantity (10,000) is assigned to the environmental threat hazardous waste quantity factor value (Ref. 1, Section 4.1.4.2.2).

Hazardous Waste Quantity Value: 10,000

4.1.4.2.3. Waste Characteristics Factor Category Value

The waste characteristics factor category value is derived by first multiplying the ecotoxicity/persistence factor value and the hazardous waste quantity factor value for the watershed (subject to a maximum of 1×10^8). This product is then multiplied with the ecosystem bioaccumulation potential factor value for the hazardous substance with the highest value in Section 4.1.4.2.1 (subject to a maximum value of 1×10^{12}) (Ref. 1, Section 4.1.4.2.3).

Ecosystem Toxicity / Persistence Factor Value = 4,000
Hazardous Waste Quantity Factor Value = 10,000
$4{,}000 \times 10{,}000 = 4 \times 10^7$

Ecosystem toxicity/persistence factor value
x hazardous waste quantity factor value: 4×10^7

Ecosystem Bioaccumulation Potential Factor Value = 50,000

(Ecosystem toxicity/persistence x hazardous waste quantity factor value)
x bioaccumulation potential factor value:
$(4{,}000 \times 10{,}000) \times (50{,}000) = 2 \times 10^{12}$
(Subject to a maximum of 1×10^{12})

The value assigned is the maximum 1×10^{12} and a value of 1,000 is assigned (Ref. 1, Section 2.4.32) as the Waste Characteristics Factor Category Value (Ref. 1, Section 4.1.4.2.3).

Hazardous Waste Quantity Factor Value: 10,000
Waste Characteristics Factor Category Value: 1,000

4.1.4.3 ENVIRONMENTAL THREAT - TARGETS

4.1.4.3.1 SENSITIVE ENVIRONMENTS

4.1.4.3.1.1 Level I Concentrations

Level I concentrations have not been established at this site.

4.1.4.3.1.2 Level II Concentrations

A Level II release has been established with chemical analyses of surface water and sediment collected from the Boulder River downstream of site sources (Ref. 8, pp. 20, 22, 25, 26; Ref. 17, pp. 5, 61). The Boulder River and Basin Creek have been designated by the State of Montana for the maintenance of aquatic life (Ref. 19, pp. 11; Ref. 36). The Boulder River and Basin Creek sensitive environments are each assigned a value of 5 for a Level II Concentrations Factor Value (Ref. 1, Section 4.1.4.3.1.2).

4.1.4.3.1.3. Potential Contamination

Sensitive Environments

The Boulder River sensitive environment was included in the Level II Concentrations Factor Value and is not included in the potentially contaminated sensitive environments (Ref. 1, Section 4.1.4.3.1.3). No other sensitive environments have been identified within the TDL.

Level I Concentrations Factor Value: 0
Level II Concentrations Factor Value: 10
Potential Contamination Factor Value: 0

4.1.4.3.1.4 Environmental Threat-Targets Factor Category Value

The environmental threat target factor category value for the watershed is the sum of the values for the Level I (0), Level II (10) and potential contamination factors (0) (Ref. 1, Section 4.1.4.3.1.4).

Environmental Threat-Target Factor Category Value = 0 + 10 + 0 = 10

4.1.4.4 Environmental Threat Score

The environmental threat score is calculated by multiplying the environmental threat factor category value for likelihood of release (550), the waste characteristics (1,000) and targets for a watershed (10). The product is rounded to the nearest integer and divided by 82,500. The resulting value, subject to a maximum of 60, is assigned as the Environmental Threat Score for the Watershed (Ref. 1, Section 4.1.4.4).

Calculations:

$$550 \times 1{,}000 \times 10 = 2{,}750{,}000$$
$$2{,}750{,}000 \div 82{,}500 = 60.00$$

Environmental Threat Score: 60.00

5.0 SOIL EXPOSURE PATHWAY

5.0.1 GENERAL CONSIDERATIONS

The Basin Tailings Pile (Source 1) and contaminated soils at the Basin School and at residences (Source 2) within the Town of Basin have concentrations of hazardous substances that exceed three times the corresponding background soil concentration (Ref. 3, pp. 37, 90; Ref. 5, pp. 19-21, 34-36; Ref. 17, pp. 65-69; Ref. 25, p. 1).

Fifteen patented mining claims associated with the Jib or Hope-Katie Mine were located in the Town of Basin within Sections 17 and 18, Township 6 North, Range 5 West (Ref. 28, p. 11). One of the most productive mines was the Jib Mill/Hope-Katie Mine Complex (Ref. 31, p. 9). Sanborn maps show that the Jib Mill Complex was also known as Basin Reduction Company, the La France Copper Company, and Jib Consolidated Mining Company (Ref. 34, pp. 3, 4, 5; Ref. 29, p. 14). An historic reference also shows that the Jib Mill Complex was known as the Basin and Bay State Mining Company (Ref. 29, pp. 9, 14). In 1887, a railroad line allowed for the transport of ores to Basin for reduction in the Basin and Bay State Mining Company's Katie Mill concentrator (Ref. 29, p. 9). Fires and floods plagued the operations over the years (Ref. 29, pp. 9-11, 14); however, in 1917, the Jib Mining Company reopened the Katie Mill concentrator and it became known as the Jib Mill (Ref. 29, pp. 14, 17). In 1923, a 300-ton mill equipped for gravity concentration and flotation was constructed (Ref. 28, p. 11). In 1933, Roy E. Miller, Inc. took over the property, overhauled the mill, and re-worked 48,300 tons of tailings by flotation (Ref. 28, p. 12). In 1953, the property was also open-pit mined by Basin-Jib Gold Mines, Ltd. (Ref. 28, p. 12)

Historic Sanborn maps show that the prevailing winds in Basin are from the southwest, i.e., from the Jib Tailings Pile (Source 4) and the Basin Tailings Pile (Source 1), toward the Town of Basin (Ref. 34, pp. 1, 2, 4, 5). Since the Town of Basin lies in a narrow valley (Ref. 6); it is likely that wind-blown distribution of emissions and metal-laden particulates from the various mills and uncontained tailings piles in the Basin area may have contributed to metal contaminated soils in the Town of Basin (Ref. 30, p. 3). In addition, the State of Montana indicates that fill material may be the source of the contamination in soils at the Basin School playground. (Ref. 21, p. 1).

Letter by which this area is to be identified: . . . . A

Name and description of the area:

Area A includes the Basin Tailings Pile in the Town of Basin, Montana. Area A previously has been referred to as Source 1, Area A (See Section 2.2 for Source 1 of this HRS package).

Location of the area:

Area A is situated in the northwest part of the Town of Basin approximately 230 feet north of Basin Street and about 600 feet north of the Boulder River in Section 17 and 18, Township 6 North, Range 5 West, Jefferson County, Montana (Ref. 6, p. 1; Ref. 4, p. 18; Ref. 7, p. 2; Ref. 47, p. 1).

Background Concentrations

Background soil samples include (BM-SO-1/MHL945) collected by EPA in 1989 EPA on the edge of the Town of Basin and BS-1-1/MHT761 collected by EPA in 1991 at the boundary of the Deerlodge National Forest (Ref. 3, pp. 37, 90, Ref. 5, pp. 34, 56).

Background Sample ID	Sample Location	Depth/ Matrix	Date	Reference
BM-SO-1, MHL945	1.5 miles west of Basin town limits	Surface Soil	7/14/89	8, pp. 23, 25; 25, p. 1
BS-1-1/MHT761	2.5 miles upstream (north) along Basin Creek at the boundary of the Deerlodge National Forest	Surface Soil	8/2/91	4, pp. 8, 9, 25, 35

Background Sample ID	Hazardous Substance	Concentration (ppm)	SQL (ppm)	Reference
BM-SO-1, MHL945	Arsenic	16.9	10.67	5, p. 34; 8, p. 25; 17, p. 65; 24, p. 1
BS-1-1, MHT761	Lead	108	0.56	3, pp. 31, 37; 24, p. 2

ppm Parts per million
SQL Sample quantitation limit

Contaminated Samples

Sample ID	Sample Location	Depth/ Matrix	Date	Reference
BM-SO-3 MHL947	Basin Tailings Pile	Surface/ Soil	7/14/89	8, pp. 13, 23, 25; 5, pp. 15, 28, 34, 58 25, p. 1

Hazardous Substance	Evidence (Sample Station, concentration in ppm)		SQL (ppm)	Reference
Arsenic	Station BM-SO-3	79.1	10.34	8, pp. 13, 23, 25; 5, pp. 15, 28, 34, 58 25, p. 1; 24, p. 8
Lead	Station BM-SO-3	1,310 B	51.71	

B Detected in laboratory blank. Quantity reported is greater than 5 times the quantity detected in the blank (Ref. 5, p. 34; Ref. 17, p. 75).
ppm Parts per million
SQL Sample quantitation limit

Hazardous Waste Quantity

Hazardous Constituent Quantity

Hazardous Constituent Quantity Value (S): NE

Hazardous Wastestream Quantity

Hazardous Wastestream Quantity Value (W): NE

Volume

Volume Assigned Value: NE

NE = Not Evaluated

Area

The area of the Basin Tailings Pile (Source 1) was calculated by digitizing the delineated, obvious extent of the pile depicted on a 1979 aerial photograph. (Ref. 7, pp. 1-2). The aerial photograph is scaled at approximately 1 inch to 500 feet (Ref. 7, p. 1).

Area of Source 1 (square feet): 26,151.00

Area covers 26,151 square feet.

To evaluate Tier D, Hazardous Waste Quantity, for Area A, the area in square feet of a waste pile is divided by the value of 34 (Ref. 1, Table 5-2).

Calculations:

Area of Source (square feet) = 26,151
Area Assigned Value = 26,151 ÷ 34 = 769.15

Area of source (square feet): 26,151

Area Assigned Value: 26,151
Area of Observed Contamination Hazardous Waste Quantity Value: 769.15

Letter by which this area is to be identified: . . . . B

Name and description of the area: Area B is the Area of Contamination (AOC) delineated by sample locations at the Basin School and residences in the northwest portion of Basin, Montana (see Source 2, Section 2.2 of this HRS package).

Residential soils in the Town of Basin, Montana, including soil at the Basin School, have been documented to contain hazardous substances at concentrations that are greater than three times the associated background concentrations (Ref. 3, pp. 9-10, 78-97; Ref. 5, pp. 21, 63; Ref. 8, p. 13; Ref. 17, p. 65; Ref. 25, p. 1; Ref. 30, pp. 1-7). Soil samples were collected from residential properties in the Town of Basin during an EPA investigation in July of 1989 and August of 1991 (Ref. 4, p. 11; Ref. 8, p. 5).

Soil in the school playground was sampled by EPA in 1989 (Ref. 7, pp. 1-2; Ref. 8, pp. 13, 44; Ref. 25, p. 1; Ref. 26, p. 1; Ref. 30, p. 5). Analysis of soil sample BM-SO-8, which was collected within the school playground, indicated that the concentration of hazardous substances in soils met the criteria for observed contamination and exceeded applicable soil benchmarks (Ref. 2, p. B-65; Ref. 5, pp. 15, 21, 34, 36, 56, 63; Ref. 8, pp. 13, 23, 25, 36; Ref. 21, pp. 1, 3, 5; Ref. 25, p. 1). All EPA samples at the Basin School were collected on the school playground. Arsenic levels detected on the Basin School property prompted the MDHES (currently known as the DEQ) to advise the Basin School Board to restrict student activity in the school's southwest playground area (Ref. 16, p. 2; Ref. 21, p. 1).

In 1991, EPA conducted an expanded site inspection (ESI) to determine the areal extent of potential soil contamination in and around the Town of Basin, Montana (Ref. 4, pp. 4-5). EPA collected 17 soil samples (0" - 6" bgs), primarily from residential properties throughout the town (Ref. 3, pp. 9-10; Ref. 4, pp.11-12). Four soil samples from Basin residences were documented to contain observed contamination (Ref. 3, pp. 9, 10, 20, 35-38; Ref. 2, pp. B-65, B-67, B-76). Soil samples were collected at the residences known in 1991 as Goodwin, Jackson, Wagner, and Beadles (Ref. 3, pp. 10, 25-29). The rural route addresses of the homes and some ownership information has changed since the 1991 ESI (Ref. 3, p. 10; Ref. 4, pp. 11-12; Ref. 11, p. 5; Ref. 13, pp. 1-2; Ref. 22, pp. 4, 7, 10; Ref. 26, p. 1; Ref. 46, pp. 1-6).

Samples BS-9-2 and BS-9-9, which were collected within 200 feet of the Jackson residence (Basin Townsite - Block 1, Amended Lot 4A), exhibited observed soil contamination (Ref. 1, Section 2.3; Ref. 3, pp. 29, 37, 38, 90, 94, 95; Ref. 4, pp. 11-12, 25, 36; Ref. 14, p. 36; Ref. 22, p. 12). Sample BS-11-4, collected from soils at the Goodwin residence (Basin Townsite - Block 1, E. 72 Ft. of Lot 2) also had observed contamination (Ref. 1, Section 2.3; Ref. 3, pp. 25, 35, 37, 79, 90; Ref. 4, pp. 11, 24, 35; Ref. 13, pp. 1-2; Ref. 22, pp. 9-11).

Soil samples BS-15-2 and BS-15-4, collected from soils within 200 feet of the Wagner property (Basin First Addition - Block 3, N. 35 Ft. of Lot 7 and Lot 8 Less E. 7.5 of S. 65 Ft.), exhibited observed soil contamination (Ref. 1, Section 2.3; Ref. 3, p. 10, 24, 26, 30, 35-36, 83, 84, 90; Ref. 4, pp. 11, 18, 24, 35; Ref. 13, pp. 1-2; Ref. 14, p. 42; Ref. 22, pp. 3-5). Soil samples BS-15-5 and BS-15-7, collected within 200 feet of the Beadles residence also exhibited observed soil contamination (Basin First Addition - Lots 9 & 10) (Ref. 1, Section 2.3; Ref. 3, p. 10, 36, 85, 86, 90; Ref. 13, pp. 1-2; Ref. 14, p. 42; Ref. 22, pp. 6-8).

Location of the area: Area B is identified as the triangular shape delineated by samples collected at the Basin School and residences within the northwest portion of Basin, Montana (Ref. 26, p. 1).

Background Concentrations

Background soil sample BM-SO-1/MHL945 was collected by EPA in 1989. Soil sample BS-1-1/MHT-761 was collected during the 1991 EPA sampling effort. These samples establish background levels of site attributable hazardous substances (Ref. 3, pp. 37, 90; Ref. 5, pp. 34, 56). Sample BS-1-1 was collected about 2.5 miles north of Basin, at the boundary of the Deerlodge National Forest (Ref. 3, pp. 37; Ref. 4, p. 12). Sample BM-SO-1 was collected about 1.5 miles west of Basin, just off I-15 (Ref. 5, pp. 15, 63).

Background Sample ID	Sample Location	Depth/ Matrix	Date	Reference
BS-1-1/MHT761	2.5 miles upstream (north) along Basin Creek at the Boundary of the Deerlodge National Forest	Surface Soil	8/2/91	4, pp. 8, 9, 25, 35
BM-SO-1, MHL945	1.5 miles west of Basin town limits	Surface Soil	7/14/89	8, pp. 23, 25; 25, p. 1

Background Sample ID	Hazardous Substance	Concentration (ppm)	SQL (ppm)	Reference
BS-1-1, MHT761	Lead	108	0.56	3, pp. 31, 37; 24, p. 2
BM-SO-1, MHL945	Arsenic	16.9	10.67	5, pp. 34, 56; 8, p. 25; 17, p. 65; 24, p. 1
	Cadmium	1.9	1.07	
	Copper	155	5.34	
	Mercury	0.13	0.11	

ppm Parts per million
SQL Sample quantitation limit

Arsenic and lead were detected in sample BM-SO-8 (MHL952) at significantly elevated concentrations (Ref. 2, p. 65; Ref. 5, pp. 34, 36, 56, 63; Ref. 8, pp. 23, 25; Ref. 16, p. 1; Ref. 25, p. 1).

Analytical results from residential soil samples indicate that arsenic, cadmium, copper, lead, and mercury were detected in concentrations that are three times greater than the background concentration (Ref. 3, pp. 9, 35-38, 80, 83, 84-86, 90, 94-95; Ref. 5, pp. 34, 36, 56, 63).

Contaminated Samples

Sample ID	Sample Location (Legal Description)	Depth	Date	Reference
BM-SO-8/ MHL952	Basin School playground	Surface	7/14/89	3, pp. 30-31 5, p. 15; 8, pp. 23, 25; 16, p. 1; 25, p. 1; 4, pp. 11-12, 18-25, 35-36; 14, pp. 36,40, 42; 13, pp. 1-2
BS-11-4/ MHT753	Goodwin residence, southwest	0-6"	8/1/91	
BS-15-2/ MHT754	Wagner residence, south	0-6"	8/1/91	
BS-15-4/ MHT755	Wagner residence, north	0-6"	8/1/91	
BS-15-5/ MHT756	Beadles residence, northeast	0-6"	8/1/91	
BS-15-7/ MHT757	Beadles residence, north	0-6"	8/1/91	
BS-9-2/MHT766	Jackson residence, east	0-6"	8/1/91	
BS-9-9/MHT765	Jackson residence, south	0-6"	8/1/91	

Hazardous Substance	Evidence (Sample Station, concentration in ppm)		SQL (ppm)	Reference
Arsenic	BM-SO-8/MHL952	990	505	5, pp. 36, 63; 3, pp. 35-38, 80, 83-86, 94-95; 24, pp. 1, 2, 6, 7; 35, p. 4
Cadmium	BM-SO-8/MHL952	10.9	1.01	
Copper	BM-SO-8/MHL952	913	5.05	
Lead	BS-11-4/MHT751	804	2.21	
Mercury	BS-11-4/MHT751	0.75 J	0.18	
Lead	BS-15-2/MHT 754	863	0.57	
Lead	BS-15-4/MHT755	4,980	0.70	
Mercury	BS-15-5/MHT756	2.2 J	0.20	
Lead	BS-15-7/MHT757	1,600	0.62	
Lead	BS-9-2/MHT766	385	1	
Lead	BS-9-9/MHT765	1,840	0.62	

J The associated numerical value is an estimated quantity because the Quality Control criteria were not met (Ref. 3, pp. 77, 80, 85).
ppm Parts per million
SQL Sample Quantitation Limit

Hazardous Waste Quantity

Hazardous Constituent Quantity

Hazardous Constituent Quantity Value (S): NE

Hazardous Wastestream Quantity

Hazardous Wastestream Quantity Value (W): NE

Volume

Volume assigned value: NE

NE = Not Evaluated

Area

Surface soil samples collected from four residences and the Basin School indicate the presence of hazardous substances significantly above background (Ref. 1, p. 51589). The Contaminated Soil Area can be delineated from the documented locations of the eight samples used to define the area of the observed contamination (Ref. 4, pp. 11-12, 18; Ref. 5, pp. 15, 36; Ref. 26, p. 1). The area of surface soil contamination covers an expanse of approximately 179,449 square feet (Ref. 26, p. 1, Ref. 27).

Area Assigned Value (square feet) = 179,449 ft^2

179,449 $ft^2 \div 34,000$ = Area Assigned Value = 5.28 (rounded)

To calculate the Area Waste Quantity Value, the Tier D, Contaminated Soil Measure will be used; the divisor for contaminated soil is 34,000 (Ref. 1, Table 5-2).

Area (square feet): 179,449 ft^2
Area Assigned Value: 5.28

Source Hazardous Waste Quantity Value: 5.28

Summary of Site Contamination

Level I Samples

Hazardous Substance	Sample Station, Area Letter B	Hazardous Substance Concentration (ppm)	Benchmark Concentration (Cancer Risk Screening Concentration [ppm])	Reference
Arsenic	BM-SO-8/MHL952	990	0.43	2, p. 65 8, pp. 23, 25; 7, p. 1; 25, p. 1; 4, pp. 11-12, 18-25, 35-36; 14, pp. 36,42; 13, p. 2

ppm Parts per million

Level II Samples

Hazardous Substance	Sample Station, Area Letter B	Hazardous Substance Concentration (ppm)	SQL (ppm)	Reference
Cadmium	BM-SO-8/MHL952	10.9	1.01	5, pp. 36, 63; 3, pp. 35-38, 80, 83-86, 94-95; 24, pp. 1, 2, 6, 7
Copper	BM-SO-8/MHL952	913	5.05	
Lead	BS-9-2/MHT766	385	1	
	BS-9-9/MHT765	1,840	0.62	
	BS-15-2/MHT754	863	0.57	
	BS-15-4/MHT755	4,980	0.70	
	BS-15-7/MHT757	1,600	0.62	
	BS-11-4/MHT751	804	2.21	
Mercury	BS-15-5/MHT756	2.2 J	0.20	
	BS-11-4/MHT751	0.75 J	0.18	

J The associated numerical value is an estimated quantity because the Quality Control criteria were not met.
ppm Parts per million
SQL Sample quantitation limit

Attribution:

Area A is composed of the Basin Tailings Pile that constitutes Source 1 (Ref. 5, pp. 20, 34, 63). Area B (Source 2) is composed of an area of contaminated soils delineated by samples with observed contamination of hazardous substances that are attributable to the site (Ref. 3, pp. 84, 95). Comparison of background soil samples BM-SO-1and BS-1-1 to soil samples collected at the Basin School and at homes within and on the edge of Basin, Montana resulted in the delineation of Area B.

A 1904 Sanborn map also shows there was an aerial tramway, ore crusher, and an ore bin on the north side of the Boulder River that is located southwest of the Basin Tailings Pile (Source 1). The tramway likely transported ore to the concentrator and/or railroad tracks on the south side of the Boulder River (i.e., Jib Mill Complex) (Ref. 34, p. 3; Ref. 26). A 1927 Sanborn map shows the presence of an ore bin, a shaft hole, and a tramway less than 50 feet west of Evans Street (Ref. 34, p. 6). Level II concentrations of metals attributable to mining activities were observed in samples collected from residences on the east side of Evans Street (Ref. 5, pp. 36, 63; Ref. 3, pp. 80, 83-86, 94, 95; Ref. 26, p. 1).

The East Katie mine is described as being located on the north side of the Boulder River at Basin almost opposite the Hope-Katie or Basin Jib mine (Ref. 28, p. 9). The East Katie vein was part of the Hope-Katie lode that had been displaced about 800 feet north due to faulting (Ref. 28, pp. 9, 12). The property was developed in 1929 by a 200-foot shaft and in 1955 the shaft was extended. The exact location of the mine has not been determined; however, the topographic map shows the location of a mine shaft north of the Boulder River at the location of the Basin Tailings Pile (Source 1 - Area A) (Ref. 6), which may be correspond to the East Katie Mine. Presently, an historic head frame is located on top of the Basin Tailings Pile, which corresponds to the location of the mine shaft (Ref. 47, p. 1).

There is little historic information detailing the processes, operation, and disposal of mining wastes within the Town of Basin; however, an historic site map depicts the locations of several mine structures and mining waste areas (Ref. 29, p. 25). Due to the number of mining claims within the Town of Basin, the successive floods and fires that plagued the Jib Mill Complex, and the era during which mining took place within Basin, Montana, it is likely that mining activities in the Town of Basin produced wastes that came to be located in Basin soils. Other potential sources that are present in Basin, Montana, but were not fully characterized include the Atwater Tailings, Wastewater Treatment Plant Tailings, and the Basin Reduction Company Smelter (Ref. 7). These have not been fully characterized with respect to the soil exposure pathway.

Available Sanborn maps from 1896, 1904, 1912, and 1927 show that the prevailing winds in Basin are from the southwest, i.e., from the Jib Tailings Pile (Source 4) and the Basin Tailings Pile (Source 1), toward the Town of Basin (Ref. 34, pp. 1, 2, 4, 5). The valley in which the Town of Basin lies is only 0.1 to 0.5 miles wide to the base of the mountains on the north and south sides of the valley (Ref. 6). Potentially, wind-blown distribution of emissions and metal-laden particulates from the various mills and uncontained tailings piles in the Basin area may have contributed to metal contaminated soils in the Town of Basin (Ref. 30). In addition, the State of Montana indicates that fill material may be the source of the contamination in soils at the Basin School playground. (Ref. 21, p. 1).

5.1 RESIDENT POPULATION THREAT

Observed contamination has been documented at the Basin School and on four residential properties (Ref. 5, pp. 36, 63; Ref. 30, pp. 6, 7; see Section 2.4.1 of Source 2 and Section 5.0 of this documentation record).

5.1.1 Likelihood of Exposure

Level I concentrations have been documented within the upper two feet of soil of the Basin School playground. Level II concentrations have been documented within the upper two feet of soil and on or within 200 feet of the Goodwin, Wagner, Jackson, and Beadles residences (Ref. 3, pp. 25-29, 35-38, 80-95; Ref. 4, pp. 18; Ref. 5, pp. 36, 63; Ref. 7, p. 1; Ref. 8, p. 13).

Resident Population Threat Likelihood of Exposure Factor Category Value: 550

5.1.2 Waste Characteristics

5.1.2.1 Toxicity

Toxicity values are based on contaminants detected at Areas A and B (Ref. 1, Section 5.1.2.1).

Hazardous Substance	Toxicity Factor Value	Reference
Arsenic	10,000	2, B-2
Cadmium	10,000	2, B-4
Copper	None assigned	2, B-6
Lead	10,000	2, B-13
Mercury	10,000	2, B-13

The highest Toxicity Factor Value of 10,000 is selected (Ref. 1, Section 2.4.1.1).

Toxicity Factor Value: 10,000

5.1.2.2 Hazardous Waste Quantity

Area Letter	Area Hazardous Waste Quantity Value	Constituent Quantity Data Complete? (Y/N)
A	769.15	N
B	5.28	N
Sum of Values:	774.43	

The sum of the source hazardous waste quantity values is assigned as the Hazardous Waste Quantity Factor Value (Ref. 1, Section 2.4.2.2) (Ref. 1, Table 2-6).

5.1.2.3 Calculation of Waste Characteristics Factor Category Value

The highest Toxicity Value is 10,000 (Ref. 2, pp. B2-B13).

A Hazardous Waste Quantity Factor Value of 100 is assigned from the sum of the Area Hazardous Waste Quantity Values of (greater than 100 to 10,000) 774 (Ref. 1, Table 2-6).

The Waste Quantity Product Value is calculated as follows:

10,000 (Toxicity Factor Value) x 100 (Waste Quantity Value) = 1×10^6 (Ref. 1, Table 2-7).

Toxicity Factor Value x Hazardous Waste Quantity Factor Value = 1×10^6

Hazardous Waste Quantity Factor Value: 100
Waste Characteristics Factor Category Value: 32

5.1.3 TARGETS

5.1.3.1 Resident Individual

Area Letter: . . . . B

Level of Contamination: . . . . Level I

Analytical results of a sample collected at the Basin School playground indicate the presence of arsenic at concentrations greater than three times background and exceeding the Soil Exposure Pathway benchmark concentration of 0.43 ppm for the cancer risk screening concentration (Ref. 1, Section 5.1.3.1, p. 51647; Ref. 2, p. B-65; Ref. 5, pp. 34, 36, 56, 63).

Resident Individual Factor Value: 50

5.1.3.2 Resident Population

5.1.3.2.1 Level I Concentrations

There are 27 students at Basin School (Ref. 5, pp. 21, 36, 63; Ref. 58, p. 1). The Level I Concentrations Factor Value equals the number of individuals subject to Level I concentrations (27) x 10, and is assigned the value of 270 (Ref. 1, Section 5.1.3.2.1).

Sum of individuals subject to Level I concentrations: 27
Level I Concentrations Factor Value: 270

5.1.3.2.2 Level II Concentrations

Using the Basin, Montana plat map (Ref. 26, p. 1), house counts noted during the EPA site visit on June 22, 1999 (Ref. 30, pp. 33-35), and the area of Area B (Ref. 27, p. 1), four properties have Level II concentrations. The Level II area of contamination is the delineated area inferred between the school sampling location (documented Level I concentration) and the residential sampling locations (documented Level II concentrations) (Ref. 3, pp. 25-29, 35-38, 80-95; Ref. 4, pp. 18; Ref. 5, pp. 36, 63; Ref. 7, p. 1; Ref. 8, p. 13; Ref. 26, p. 1). Information compiled in 1999 from the Boulder County Assessor's office and Basin, Montana house counts indicate the presence of occupants in all four residences on sampled property (Ref. 13, pp. 1-2; Ref. 22, pp. 6-12). Jefferson County, Montana census data from 1990 indicates an average of 2.68 individuals per residence (Ref. 15, pp. 1-2). Approximately 10 residents are associated with the properties subject to Level II concentrations of contamination.

Area Letter	Resident Individuals			
	Residences	County Multiplier	Reference	Total Residents
B	4	2.68	15, pp. 1- 2	10
				10

Sum of individuals subject to Level II concentrations (rounded): 10

Level I Concentrations Factor Value: 270
Level II Concentrations Factor Value: 10

5.1.3.3 Workers

Workers were not included; therefore a factor of 0 is assigned (Ref. 1, Section 5.1.3.3, Table 5-4).

Workers Factor Value: 0

5.1.3.4 Resources

No soil resource use is known to exist in Basin, Montana and a value of 0 is assigned to the Resource Factor Value (Ref. 1, Section 5.1.3.4; Ref. 3, pp. 19-20).

Workers Factor Value: 0
Resources Factor Value: 0

5.1.3.5 Terrestrial Sensitive Environments

No terrestrial sensitive environments situated on documented areas of contamination have been identified at the Basin Mining Area site and a Terrestrial Sensitive Environment Factor Value of 0 is assigned (Ref. 1, Section 5.1.3.5).

5.1.3.6 Calculation of Resident Population Targets Factor Category Value

The Resident Population Targets Factor Category Value is calculated by summing the values for resident individual (50), resident population (270 + 10 = 280), workers (0), resources (0), and terrestrial sensitive environments (0) factors (sum not rounded to nearest integer) (Ref. 1, Section 5.1.3.6).

50 + 280 + 0 + 0 + 0 = 330

5.1.4 Calculation of Resident Population Threat Score

The Resident Population Threat Score is calculated by multiplying the values for likelihood of exposure (550), waste characteristics (32) and targets for the resident population threat (330) (product rounded to nearest integer) (Ref. 1, Section 5.1.4).

550 x 32 x 330 = 5,808,000

Terrestrial Sensitive Environments Factor Value: 0
Resident Population Targets Factor Category Value: 330
Resident Population Threat Score: 5,808,000

5.2 Nearby Population Threat

The nearby population threat was not scored because the Soil Exposure Pathway was evaluated based on resident population threat.

5.3 Calculation of Soil Exposure Pathway Score

The Soil Exposure Pathway Score is calculated by summing the resident population threat score and the nearby population threat score and dividing the sum by 82,500, subject to a maximum value of 100 (Ref. 1, Section 5.3).

(Resident Population Threat Score + Nearby Population Threat Score)/82,500 =
Soil Exposure Pathway Score

(5,808,000+ 0)/82,500 = 70.40 (Subject to a maximum of 100: Ref. 1, Section 5.3)

Soil Exposure Pathway Score: 70.40

Soil Exposure Pathway Score: 70.40